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NORMAL VARIATION OF TEETH AND JAWS, AND ORTHODONTY*

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UNDER strictly healthy conditions the jaws and teeth tend to develop "normally" and the teeth to assume a close harmonious apposition which is termed normal occlusion.

In reality, a perfect occlusion in man is seldom realized; a fairly close approach to it, however, was general in earlier man and is common in all healthy primitive peoples; but this harmony is frequently disturbed in modern civilized man, and in those primitive groups which come under the influences of civilization. Such disturbances are known as malocclusions.

Malocclusions, though not exclusively, are manifested essentially in the permanent denture. They show especially during the middle three-fifths of the developmental period of the permanent teeth, and they assume a wide range of forms, which on the basis of their outstanding features have been classified into a number of types or classes.

This classification is doubtless serviceable to the dental practitioner; but like all efforts at any rigid subdivision of complex biogenic processes, it involves a number of dangers, the two main of which are (1) the impression of a natural segregation, and (2) that of permanency.

Study of the dentures of many different peoples and at different ages shows both of the above notions to be erroneous. There is no line of demarcation between the several types or classes of malocclusion. They all merge gradually into each other, so that the whole range of these deviations from the normal if arranged consecutively would present an uninterrupted line. This implies that any subdivisions of this line, any classification of malocclusions, can only be conventional.

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Neither is there any absolute permanency. There are evidences that malocclusions, particularly those of the earlier ages, are not wholly stable conditions, but tend to change with time, and that generally, if other conditions regarding the individual are favorable, in the direction of a better or more "workable" accommodation. These facts deserve a thorough consideration.

Of equal importance to the foregoing general conceptions of the subjects are those of the causes of malocclusion. There, too, a clear light in the minds of all concerned—as far as it may for the present be possible—is highly desirable. Perhaps our experiences on the vast skeletal materials now at our disposal may be of some value in this connection. They are as follows:

a. The main causes of malocclusions in the permanent teeth appear to be retardations of eruption of some of the teeth. It is possible that this in some instances involves really a double phenomenon, namely, precociousness of eruption of some and either a relative or absolute retardation in the eruption of other of the dental elements. The most guilty single retarder and most potential of mischief appears to be the canine; but no definite assertions can be made on any part of this problem without further and ample studies of the conditions.

b. The second main category of causes of malocclusions are all the agencies, of degenerative or pathologic nature, that cause serious, generalized or localized disturbances in blood supply or innervation of the dental or bony parts concerned during the period of their development. Hereditary progressive irregular weakenings in the dental elements and the jaws are probably the main basic reasons; but constitutional and serious childhood diseases take doubtless also a high rank in these connections.

c. A cause not seldom invoked in cases of malocclusion is a differing heredity in the size of the jaws and teeth, the conception being that in cases of mixtures where these parts differ markedly in the two parents, the children may inherit large teeth from one with small jaws from the other parent, or other disharmonious conditions. These are assumptions backed by no scientific determinations. Parental differences in the size of the teeth and jaws are the general rule in man, and also in many animals; the canines and tusks in many species differ greatly in the two sexes; there are innumerable hybrids between the whites and the negro, the whites and the Indian or Eskimo, and between other races; yet no disharmonies are perceivable in any of these, under normal conditions. Only when abnormal states and pathologic conditions affect the jaws or teeth will discordances manifest themselves. According to all indications the normal heredity of the teeth and the jaws is, aside from what is sex linked, a blend heredity, as that of many other and particularly epidermal features of the body, and not the simple mendelian inheritance with its dominance, recessiveness, and segregations.

The rôle of the orthodontist is the correction of dental and maxillary irregularities with the consequent malocclusions. From the point of view of a general student of these structures a rational treatment of such abnormalities would seem to embrace, on one hand, a constant consciousness of the basic realities of the subject and, on the other, a consciousness of the danger con-

fronting the procedures of correction. The main of these dangers, again as seen by the outsider, would be:

1. Insufficient regard, during the period of childhood especially, but also in adolescence, of the unfinished development of the jaws and accommodation of the teeth.

2. The allure of bringing all dentures to one ideal type.

3. The acceptance of fixedness for any of the points from which it is necessary to take measurements.

These items are of such practical importance that they justify some discussion.

When the student commands a sufficiently large amount of living subjects, and especially of the skeletal materials, from the periods of childhood and adolescence, it is easy to see that at no time up to, say, eighteen years of age, is he confronted in the jaws and teeth with complete, finished products. The palate, the dental arches, everything changes until there are reached the adult conditions, and the changes in the arches especially are, collectively, very material. All this means that at no time during this long developmental and growth period are we confronted in the jaws and the dental arches with full-fledged conditions; and at no time during the earlier parts of this period, on the basis of present knowledge, can the observer more than surmise as to what the conditions will be when the growth of the parts is completed. Moreover this applies not only to the normal hereditary developments, but also more or less to abnormal and pathologic conditions.

To make matters still clearer it may be stated that at no time during the developmental and growth period does the dentomaxillary apparatus represent the full and final influence of the hereditary potentialities of the individual, or the full and final results of the tendency at adaptation. The hereditary expressions at any age, but especially during childhood, are incomplete, and later hereditary discharges may alter conditions. The period of puberty is often particularly active in changes of this nature. The import of all this to the orthodontist must, I think, be plain.

The search for an ideal type of the dental arches runs counter to even the most normal natural tendencies and hence is foredoomed to failure. Whatever feature, whatever character, and whatever function of the human body may be taken, the student finds that under even the most normal conditions nature does not proceed along a narrow path of uniformity but along a broad avenue of variation. Determine, on sufficient material, the normal average of any feature, be it any of the dimensions or regular characters of a tooth, or the size or form of the dental arches, and a careful scrutiny will show that while the majority of cases will range themselves near the mean, there will be others that, without any disconnection or abnormality, will reach as far, perhaps, as 20 per cent of the average both one way and the other. This teaches that whatever ideal concerning the teeth or arches or jaws may be set up, there must be made an allowance of from 20 to 40 per cent of the average for the normal variation of such an ideal. The significance of this to orthodonty must be obvious.

Yet that is not all. Besides this normal variation there is noticeable also, in many if not all the more definite features of the human organism, a tendency toward a segregation into more than one type. This tendency is especially marked in the skeletal parts and includes the jaws, more particularly the maxilla. As a result of this there is not merely one form of the normal maxillary dental arch and palate, but there exist several such forms, each with its own range of variation and of intermediates. The anthropologists, including myself,[1] have repeatedly called attention to these types. It is true that they are mostly the end-products of growth and differentiation of the parts concerned; yet their foreshadows are met with earlier and call for more attention by the orthodontist than they have hitherto received.

The intensive desire on the part of the orthodontists to find immutable points on the jaws, face or head, from which to take the measurements they are in need of, is but natural. If such points could be had, it would help greatly. That is why many cling so tenaciously to Simon or any other authority who advocates some definite landmarks. Regrettably such strivings are futile. There are no fixed points, except in the average obtained on a large series of individuals. Every one of the landmarks that ever was or could yet be advocated is subject to precisely the same phenomenon of normal variation as has been dealt with in the foregoing section. Connolly and others have shown this[2] about the Simon's points, and the same could be shown about any others. Even the excellent work of Hellman on facial growth and changes suffers necessarily from this obstacle. Whatever point for prospective measurements may be chosen by the orthodontists or any other research workers will surely differ, and that often materially, in different individuals, at different ages, and even on the two sides of the head or face of the same individual. Here is a natural limitation to our efforts, with which it is well to be acquainted fully and for which a discount must be made in our procedures.

DATA ON VARIATION

The subject of normal variation of the teeth, the dental arches, the palate, and the jaws has been dealt with more or less by many authors but is still far from being fully covered.

The most comprehensive data on the variation of the teeth were given by G. V. Black.[3] It is not known to what numbers of specimens these measurements extended, but these numbers were evidently fairly large. It is also not stated just to whom, racially, these teeth belonged, but presumably they were mainly if not entirely those of the American whites. The data are of such originality and interest that their essentials deserve to be here reproduced.*

In addition I am able to present four tables which give the individual variation of the mandible in the United States adult whites, and of the mandibular molars in the United States whites, a number of tribes of the North American Indians and the Alaskan Eskimo.[4, 5]

*The ranges of variation have been determined, from the minima and maxima of each item, by the present writer.

TABLE I

MEASUREMENTS OF PERMANENT TEETH AND THEIR VARIATIONS

	MAXILLARY TEETH					MANDIBULAR TEETH				
	LENGTH OVER ALL	HEIGHT OF CROWN	LENGTH OF ROOT	MESIO-DISTAL DIAMETER OF CROWN	BUCCO-LINGUAL DIAMETER OF CROWN	LENGTH OVER ALL	HEIGHT OF CROWN	LENGTH OF ROOT	MESIO-DISTAL DIAMETER OF CROWN	BUCCO-LINGUAL DIAMETER OF CROWN
Central incisor										
Average	22.5	10.0	12.0	9.0	7.0	20.7	8.8	11.8	5.4	6.0
Range of variation in per cent of average	40.0	40.0	66.7	22.2	14.3	38.7	39.8	59.3	18.5	16.7
Lateral incisor										
Average	22.0	8.8	13.0	6.4	6.0	21.1	9.6	12.7	5.9	6.4
Range of variation in per cent of average	40.9	28.4	61.5	31.3	33.3	42.7	52.1	47.2	25.4	23.4
Canine										
Average	26.5	9.5	17.3	7.6	8.0	25.6	10.3	15.3	6.9	7.9
Range of variation in per cent of average	45.3	42.1	49.1	26.3	25.0	48.8	38.8	65.4	58.0	50.6
First premolar										
Average	20.6	8.2	12.4	7.2	9.1	21.6	7.8	14.0	6.9	7.7
Range of variation in per cent of average	26.7	24.4	32.3	13.9	22.0	37.0	32.1	50.0	29.0	13.0
Second premolar										
Average	21.5	7.5	14.0	6.8	8.8	22.3	7.9	14.4	7.1	8.0
Range of variation in per cent of average	41.9	26.7	64.3	29.4	28.4	35.9	50.6	41.7	21.1	25.0
First molar										
Average	20.8	7.7	15.2	10.7	11.8	21.0	7.7	13.2	11.2	10.3
Range of variation in per cent of average	33.7	26.0	45.5	28.0	15.3	28.6	39.0	30.3	8.9	14.6
Second molar										
Average	20.0	7.2	13.0	9.2	11.5	19.8	6.9	12.9	10.7	10.1
Range of variation in per cent of average	40.0	27.8	61.5	32.6	21.7	20.2	29.0	15.5	9.35	9.9
Third molar										
Average	17.1	6.3	11.4	8.6	10.6	18.5	6.7	11.8	10.7	9.8
Range of variation in per cent of average	46.8	47.6	61.4	46.5	61.3	21.6	29.9	76.3	37.4	15.3

After G. V. Black. Arrangement and calculations of quotient of variation by present author.

TABLE II

VARIABILITY OF THE MANDIBLE

UNITED STATES WHITES—MISCELLANEOUS

DIMENSION	SIDE	MALE				FEMALE			
		NUMBER OF SPECIMENS	AVERAGE (CM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$	NUMBER OF SPECIMENS	AVERAGE (CM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$
Anteroposterior diameter (of whole jaw)		51	7.50	6.6- 8.9	30.7	22	7.02	6.2 - 7.7	21.4
Bigonial diameter		50	10.11	9.1-11.0	18.8	22	9.14	7.85-10.4	20.7
L B Index: $\frac{\text{D. a-p} \times 100}{\text{D. big.}}$		50	74.8	64.4-87.2	30.5	22	76.8	65.3 -90.6	33.–
Minimum breadth of ramus	R	45	3.15	2.6- 3.8	38.1	20	2.86	2.4 - 3.35	33.2
	L	45	3.15	2.6- 3.65	33.3	20	2.90	2.35- 3.45	37.9
Height of ramus		53	6.54	5.5- 7.5	30.6	28	5.83	4.9 - 6.7	30.9
Left ramus index: $\frac{\text{B} \times 100}{\text{H}}$		53	47.6	37.–61.8	52.1	28	49.7	39.4 -67.6	56.8
Height at symphysis		57	3.30	2.9- 4.0	33.3	32	2.88	2.5 - 3.2	24.3
Mean thickness at M_2		51	1.45	1.– 1.8	55.2	21	1.28	1.1 - 1.4	23.4

TABLE III

MANDIBULAR MOLARS: VARIATION IN SIZE

AMERICAN WHITES—MISCELLANEOUS

DIMENSION	SIDE	MALE				FEMALE			
		NUMBER OF TEETH	AVERAGE (MM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$	NUMBER OF TEETH	AVERAGE (MM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$
		M_1				M_1			
Length	R	20	10.60	9.5- 12.5	28.3	20	10.78	10.0- 11.5	13.9
	L	20	10.50	9.5- 12.–	23.8	20	10.78	10.0- 11.5	13.9
Breadth	R	20	10.51	8.5- 12.5	38.1	20	10.11	9.5- 11.–	14.8
	L	20	10.52	9.— 12.–	28.5	20	10.13	9.5- 11.–	14.8
L B Index	R	20	99.2	90.9-105.3	14.5	20	93.9	86.4-100.–	14.5
	L	20	100.1	90.9-105.3	14.4	20	94.–	86.4-100.–	14.5
		M_2				M_2			
Length	R	20	10.39	8.5- 12.5	38.5	20	10.32	9.— 11.5	24.2
	L	20	10.42	9.— 12.5	33.6	20	10.35	9.— 11.5	24.1
Breadth	R	20	10.28	8.5- 12.–	34.1	20	9.80	8.5- 11.–	25.5
	L	20	10.23	8.5- 12.–	34.2	20	9.84	8.5- 11.–	25.4
L B Index	R	20	98.9	88.7-106.7	18.2	20	95.–	81.8-100.–	19.2
	L	20	98.2	88.7-112.–	20.8	20	95.1	86.4-100.–	14.3

TABLE IV

DIMENSIONS AND VARIABILITY OF FIRST TWO PERMANENT MOLARS

NORTH AMERICAN INDIANS

CORRESPONDING TEETH OF BOTH SIDES	MALE				FEMALE			
	PUEBLOS (OLD)	KENTUCKY (OLD)	ARKANSAS (OLD)	SIOUX (LATE)	PUEBLOS (OLD)	KENTUCKY (OLD)	ARKANSAS (OLD)	SIOUX (LATE)
Number of jaws	(10)	(20)	(10)	(10)	(10)	(20)	(10)	(10)
Number of teeth (first molars)	(20)	(40)	(20)	(20)	(20)	(40)	(20)	(20)
Crown:								
Length	11.13	10.56	11.42	11.71	10.59	10.89	11.–	11.28
Range of variation	10.0-12.0	9.5-11.5	10.5-12.5	11.0-13.0	9.5-11.6	9.0-12.0	10.5-11.5	10.5-12.5
Quotient of variability	18.–	18.9	17.5	17.1	19.8	27.6	9.1	17.7
Breadth	10.95	11.32	11.12	11.38	10.12	10.94	10.80	10.92
Range of variation	10.0-12.0	10.5-12.0	10.0-12.0	10.0-12.5	9.5-11.0	10.0-12.0	10.2-11.2	10.0-11.8
Quotient of variability	18.3	13.3	22.3	22.–	14.8	18.3	9.3	16.5
L B Index	98.3	107.3	97.4	97.2	95.6	100.5	98.1	96.7
Range of variation	87.0-107.5	100.0-120.0	90.9-104.8	90.9-102.5	90.7-103.2	90.9-116.7	93.9-101.8	89.6-104.8
Quotient of variability	20.9	18.6	14.3	11.9	13.1	25.7	8.1	15.7
Number of jaws	(10)	(20)	(10)	(10)	(10)	(20)	(10)	(10)
Number of teeth (second molars)	(20)	(40)	(20)	(20)	(20)	(40)	(20)	(20)
Crown:								
Length	10.53	11.01	10.98	11.60	9.70	10.28	10.51	10.98
Range of variation	9.0-11.5	8.5–12.0	10.0-11.5	10.5-13.5	9.0-11.0	9.0-11.0	10.0-11.5	10.5-12.0
Quotient of variability	19.–	31.8	13.7	25.9	20.6	19.5	14.3	13.7
Breadth	10.47	11.15	10.80	11.21	9.67	10.53	10.35	10.61
Range of variation	10.0-11.5	10.5-12.5	9.8-11.5	10.0-12.0	9.0-11.0	9.5-11.5	10.0-11.5	10.0-11.5
Quotient of variability	9.6	17.9	15.7	17.8	20.7	19.–	14.5	14.1
L B Index	99.4	106.1	98.3	96.7	99.6	102.2	98.5	96.6
Range of variation	90.9-111.1	95.5-126.3	91.3-105.9	88.9-106.7	90.5-105.6	90.5-116.7	93.6-107.8	90.0-104.8
Quotient of variability	20.3	29.0	14.9	18.4	15.2	25.6	14.4	15.3

TABLE V

FIRST AND SECOND MANDIBULAR MOLARS: VARIATION IN SIZE

ALASKAN ESKIMO

DIMENSION	SIDE	MALE				FEMALE			
		NUMBER OF TEETH	AVERAGE (MM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$	NUMBER OF TEETH	AVERAGE (MM.)	RANGE OF VARIATION	QUOTIENT OF VARIABILITY $\left(\frac{\text{RANGE} \times 100}{\text{AVERAGE}}\right)$
		M_1				M_1			
Length	R	20	11.28	10.5- 10.3	17.7	20	11.70	10.5- 12.0	12.8
	L	20	11.14	10.0- 12.5	22.4	20	11.16	10.5- 12.0	13.4
Breadth	R	20	11.02	10.0- 11.5	13.6	20	10.76	10.0- 12.0	18.6
	L	20	11.08	10.0- 11.7	15.3	20	10.87	10.0- 12.0	18.4
L B Index	R	20	97.7	90.4-104.8	14.7	20	96.4	90.9-100.0	9.4
	L	20	99.5	90.4-110.0	19.7	20	97.4	90.9-104.4	13.9
		M_2				M_2			
Length	R	20	11.11	9.5- 12.0	22.5	20	10.78	10.0- 12.0	18.6
	L	20	11.–	9.5- 12.0	22.7	20	10.68	9.7- 12.0	21.5
Breadth	R	20	10.84	9.5- 12.0	23.1	20	10.48	9.5- 12.0	23.9
	L	20	10.85	9.5- 11.8	21.2	20	10.58	9.5- 12.0	23.6
L B Index	R	20	97.3	90.9-104.5	14.–	20	97.2	87.5-104.8	17.8
	L	20	98.7	91.3-104.8	13.7	20	99.1	89.2-104.8	15.7

It will be seen that the quotient of variability $\left(\frac{\text{range of variation}}{\text{average}} \times 100\right)$ is notable, reaching in some groups and measurements to nearly 40 per cent of the average in the case of the teeth and to over 50 per cent of the average in the case of some of the measurements of the jaws. Yet none of these groups are sufficiently large to give the full range of variations. It has been found in anthropometry that to obtain the full range, or very near to it, at least two hundred specimens of each kind are required. Had we such ample series, the range of individual variation would be still materially higher than that shown by our tables.

It may further be noted that these variations apply to each sex separately.

The evidence I believe demonstrates conclusively one of the main points which I intended to accentuate in this paper, namely, that even under normal conditions the orthodontist is confronted on every side and in every feature of the teeth and jaws with the fact of extensive variability. Add to this the effects of pathologic conditions and it will be appreciated that the orthodontist's tasks in view of this phenomenon alone are far from simple and enviable.

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DISCUSSION

Dr. Milo Hellman.—It is always a pleasure to listen to what Dr. Hrdlička has to offer. But to have the privilege of formally discussing one of his contributions I consider a distinct honor. Dr. Hrdlička is unusually qualified for keen observation, critical analysis, and practical suggestions. To these he adds a sympathetic attitude which goes a long way to be of real help.

In his present contribution, Dr. Hrdlička has given a brief but penetrating survey of the status of orthodontia as it appears to an anthropologist who has considerably more than a superficial knowledge of our specialty. It would be futile for me to discuss any of the scientific principles set forth by Dr. Hrdlička. But finding myself in the dilemma of an official discusser, I am really obliged to do something. The only hopeful feature about it is that I am fortunate enough to occupy an enviable position: among anthropologists I am considered a good orthodontist, and among orthodontists a good anthropologist. Due to this unique situation I have often had the opportunity to speak of orthodontia to anthropologists and of anthropology to orthodontists. Under such circumstances, if I happen to go wrong, it is easy to find a way out. It would seem that the present situation would warrant my assuming the rôle of the orthodontist. As such, I have no alternative but to endorse most heartily a great deal Dr. Hrdlička has said. The best I can do is to substantiate some of his ideas with proof derived from my own studies. For instance, that normal occlusion of the teeth is not an exclusive feature of many groups of people, primitive or civilized, is shown in Table I, worked out from data of nineteen racial and local groups on adult skulls in the collections of several museums. As shown in this table, normal occlusion of the dentitions to the extent of 100 per cent is the exception among the ten adult male skulls of South African negroes. The range of male dentitions with

normal occlusion among the other groups is from 33 per cent in the Chinese, Japanese and Carinthian whites to 93.8 per cent in the ancient American Indians. Among the females the 100 per cent exception is shown in the dentitions of the seven skulls of East African negroes; while the range is from 20 per cent of the ancient American Indians and the Chinese to 94 per cent in the Buriats. Curiously enough, the dentitions of the ancient American Indians, which show the highest percentage of normal occlusion in the males, show the lowest in the females. Of course, no significance should be attached to this,

TABLE I

RATIO OF THE NORMAL AND ABNORMAL IN OCCLUSION OF THE TEETH IN VARIOUS RACES

RACE	MALE			FEMALE		
	TOTAL NO.	NORMAL OCCL.	PER CENT NORMAL	TOTAL NO.	NORMAL OCCL.	PER CENT NORMAL
Ancient Amerind	16	15	93.75	5	1	20.00
Modern Amerind	21	18	85.71	14	13	92.85
Eskimo	14	7	50.00	--	--	----
Hindu	20	14	70.00	19	11	57.84
Japanese	12	4	33.33	3	2	66.67
Mongol (Borneo Chinese)	9	3	33.33	5	1	20.00
Mongol (Buriat)	15	11	73.33	17	16	94.12
Tasmanian	7	5	71.43	4	3	75.00
Australian	8	7	87.50	6	3	50.00
Negro (East African)	26	19	73.08	7	7	100.00
Negro (South African)	10	10	100.00	--	--	----
Negro (West African)	50	34	68.00	26	17	65.38
Negro (W. R. U.)	43	40	93.02	--	--	----
White (Salzburg)	5	0	00.00	--	--	----
White (Carinthian)	6	2	33.33	1	0	00.00
White (W. R. U.)	62	42	67.74	4	2	50.00
White (Demko-Hegy)	16	11	68.75	25	16	64.00
White (Keszo Hidegkut)	58	36	62.07	50	24	48.00
White (Szarazd)	29	18	62.07	13	10	76.92

TABLE II

COMPARISON OF THE NUMBERS IN TYPE 1 (SUBCLASSES A AND B), TYPE 2 (SUBCLASSES A AND B) AND TYPE 3 (CLINCH)

	A (WITH SPACE)	B (WITHOUT SPACE)	TOTAL
Type 1	204 (73%)	76 (26%)	280 or 70%
Type 2	46 (42%)	62 (58%)	108 or 27%
Type 3		12	12 or 3%
	250	150	400

TABLE III

COMPARISON OF THE NORMAL AND ABNORMAL IN OCCLUSION EXPRESSED IN PERCENTAGE

AGE	BOYS			GIRLS		
	NO.	NORMAL	ABNORMAL	NO.	NORMAL	ABNORMAL
5	15	68.75	31.25	17	70.58	29.42
6	32	30.31	69.69	33	39.39	60.61
7	64	18.75	81.25	41	29.26	70.74
8	76	25.97	74.03	47	19.15	80.85
9	88	17.04	82.96	54	27.77	72.23
10	72	16.66	83.34	49	30.61	69.39
11	68	27.94	72.06	51	37.25	62.75
12	72	31.91	68.19	43	30.23	69.77
13	45	33.33	66.67	40	32.50	67.50
14	36	30.55	69.45	33	36.36	63.64
15	25	38.46	61.54	12	41.66	58.34

since the number of female skulls is so very small. This shows that even among the most primitive people the dentitions, with the exception of those of the South African male negroes and the East African female negroes, are not exclusively in normal occlusion.

But what I, as an orthodontist, cannot quite agree with is that "Malocclusions, though not exclusively, are manifested essentially in the permanent denture." In Table II is given an account of malrelation of the jaws, as found by Miss Lilah Clinch of London in

Fig. 1.

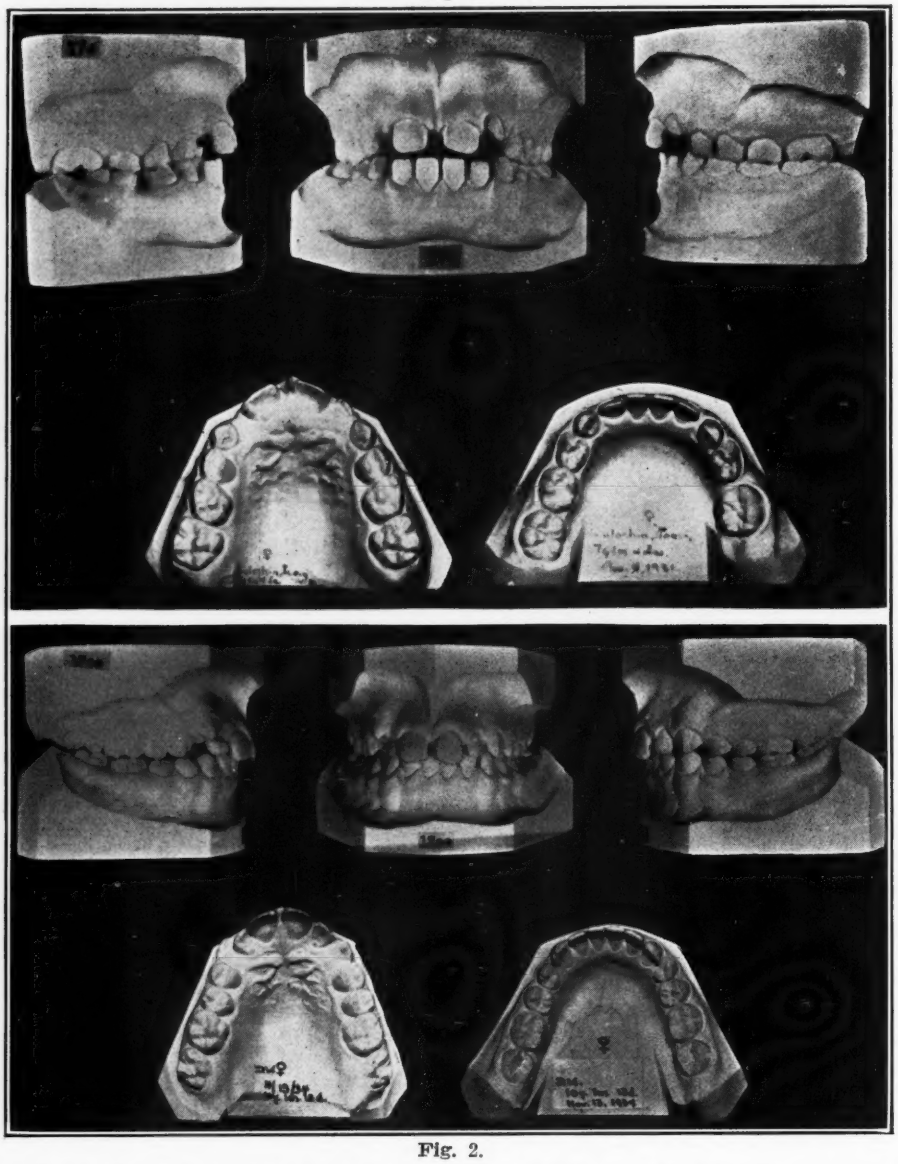

Fig. 2.

Fig. 1.—Casts of dentition of girl, aged seven years, showing abnormal frenum, large diastema between maxillary central incisors, rotated maxillary lateral incisor, prematurely lost mandibular right deciduous second molar, the space of which is almost entirely closed.

Fig. 2.—Casts of dentition of girl shown in Fig. 1, aged ten years, showing closing diastema between maxillary central incisors, erupted and self-corrected maxillary lateral incisors, self-opened space for mandibular right second premolar which has erupted and is in normal occlusion. So far no orthodontic treatment was deemed necessary.

a study of 400 infants at birth. Even at this early period of life Miss Clinch has found that the relationship of the jaws is of a threefold variety or type. The first is normal and appears in 70 per cent of the children, and the other two types are malrelationships

appearing in 30 per cent of them. It is thus clear that already at birth, before any teeth are present at all, there are malrelations of the jaws to the extent of 30 per cent. In Table III is given an account of the incidence of malocclusion in children from five years to fifteen years. Thus at five years, when the deciduous dentition is still intact, malocclusion appears to the extent of 31 per cent in boys and 30 per cent in girls. There is then a gradual increase in the incidence of malocclusion up to eight years in girls and

Fig. 3.

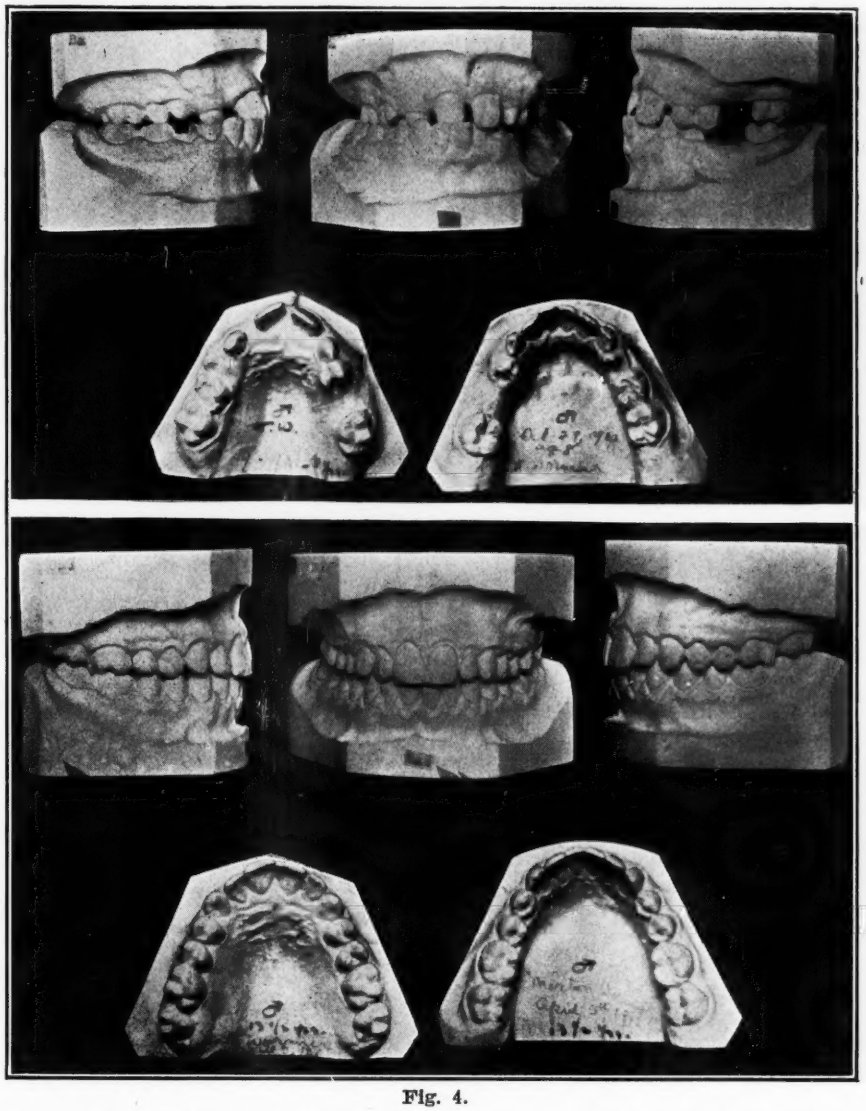

Fig. 4.

Fig. 3.—Casts of dentition of boy, aged eight years, showing case of malocclusion which was treated.

Fig. 4.—Casts of dentition of boy shown in Fig. 3, showing result of treatment three years after discarding all appliances.

ten years in boys, decreasing again until the age of fifteen years when the deciduous teeth have been replaced by their permanent successors.

Dr. Hrdlička is perfectly right in condemning our classifications of malocclusion, but this really does not help much. Our classification (Angle's) has won universal recognition, and practically it is very useful. His suggestion to consider it as conventional should, however, be kept in mind. Also the fact that there is a gradual transition from one class

to another is worth while remembering. But, when it comes to actual treatment, the orthodontist, if he expects to get anywhere, really cannot avoid the employment of distinctly different procedures in the different classes of malocclusion.

In speaking of the rôle of the orthodontist, Dr. Hrdlička is regrettably correct in many respects. In the majority of cases there is, unfortunately, a widespread disregard of "the period of childhood as well as of the potentialities of development." It is only

Fig. 5.—Casts of maxillary dentition, showing occlusal view of dental arches of case of boy shown in Figs. 3 and 4. *A* shows the form of the maxillary dental arch before treatment; *B*, at completion of treatment; and *C*, three years after appliances were discarded.

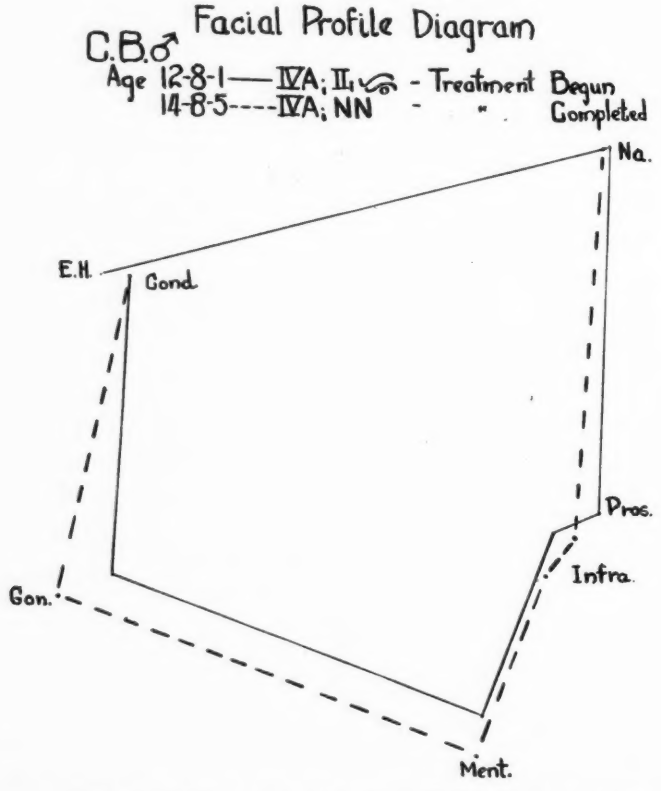

Fig. 6.—Facial profile diagram of boy with Class II Division 1 malocclusion of the teeth, showing changes produced by orthodontic treatment. Solid line diagram of measurements taken before treatment; broken line diagram after treatment. Na. = nasion; Pros. = prosthion; Infra. = infradentale; Ment. = menton; Gon. = gonion; E. H. = ear hole; Cond. = condylion.

by means of orthodontic procedures which rest on scientific knowledge, if that is what Dr. Hrdlička means by "rational treatment," that the dangers pointed out by him can be avoided. For example, in a case such as is shown in Fig. 1 the period of childhood should be fully recognized and the potentialities of development taken into account. In doing so, no mechanical manipulation should be attempted, although it may be strongly desired by the parents. The child in this instance was not treated; although it would

be indicated by the large space between the maxillary incisors and the apparently large frenum, the rotated maxillary left lateral incisor and the closed up space of the mandibular right deciduous molar, which was extracted. . This girl, seven years of age, was kept under observation. Examinations were made periodically every three months to watch carefully the development of the dentition. In the course of three years the result shown in Fig. 2 was the outcome of this procedure. The case is still under observation, and, since there is sufficient room for the misplaced upper right canine, further improvement is to be expected. If, on the other hand, a condition presents itself in the form shown in Fig. 3, where there is little hope for a successful natural outcome, with due regard for the child period, no confidence should be placed in the potentialities of development. Something must be done about it. In this case orthodontic procedures were carefully executed with the result shown in Fig. 4. That the results obtained by orthodontic treatment need not

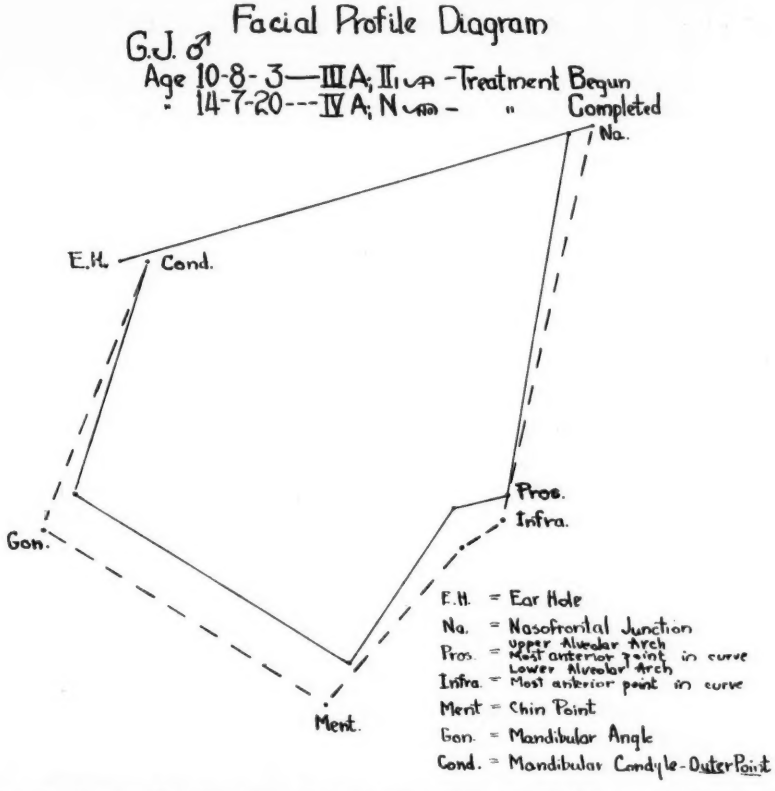

Fig. 7.—Facial profile diagram of boy with Class II Division 1 malocclusion, showing reverse change in profile produced by orthodontic treatment. Solid line diagram of measurements taken before treatment; broken line diagram after treatment. Na. = nasion; Pros. = prosthion; Infra. = infradentale; Ment. = menton; Gon. = gonion; E. H. = ear hole; Cond. = condylion.

be aimed at shaping the dental arch form according to an imaginary ideal is clearly shown by the arch form attained in this case. Fig. 5 (occlusal view) gives the comparative series of the maxillary dental arch (*A*) before treatment, (*B*) after treatment, and (*C*) three years after the retaining appliances had been discarded. Many examples of this sort are now available, but in a discussion of this sort only a sample of them can be shown. I hope Dr. Hrdlička will agree that, in spite of the fact that the results in such cases are close to the ideal [many other cases were shown by means of lantern slides, but are not illustrated here] there has been no slavish chase after a phantom, since there is abundant variety in arch forms to suit each case.

Dr. Hrdlička's reference to fixed points from which measurements are made, I fully endorse and heartily approve. But can they be dispensed with? Even anthropometry is

not entirely free from them. Is not the Frankfort plane but an arbitrary conception? It should, however, be stated that in orthodontic treatment anthropometric procedures have as yet proved to be of no real practical use. So far as I know, those who believe that measurements of the face or of the casts of the dentitions are a panacea for all orthodontic ills are in most instances looking for an excuse to begin treatment. If not this, then they either fail to recognize the real orthodontic problem or have been using the various so-called scientific schemes as a sort of alibi to cover their orthodontic failures.

Anthropometric measurements, however, if used intelligently, *are* of scientific value. To be sure, we are as yet not able to use anthropometric records as a means to indicate what facial changes should be made by our empirical mechanical procedures. But anthropometric measurements carefully taken and intelligently used do show what changes *have taken place*, particularly if rational orthodontic treatment has been carried out with success. For this purpose, the illusion about "fixedness" of the points from which measurements are taken is not a serious impediment. For instance, the facial appearance of successfully treated cases of malocclusion belonging to Class II Division 1 is quite familiar to all acquainted with successful orthodontic results.* The effect of treatment upon the dentition and upon the face, i. e., what really happens in the changes produced by the correction of the occlusion of such cases, is not clear at all. Some claim that the mandibular dental arch is moved forward; others that the maxillary is moved backward. If, however, such facial profile diagrams, as shown in Fig. 6, are worked out from anthropometric records made before and after treatment, although quite arbitrary, they nevertheless show very clearly that in the treatment of this case the maxillary dental and alveolar arches were shifted backward to meet the mandibular arch in the establishment of normal occlusion. Again, in another case, Class II Division 1, which was not unlike the previous one and the result of which again was very successful, the effect upon the face, as shown in Fig. 7, is entirely different. Thus, using the arbitrary anthropometric device, Fig. 7, it is shown that the mandibular dental and alveolar arches in this case were shifted forward.

Now it does not matter, so far as I can see, whether the points from which the measurements are made are fixed or not. In fact, they are not, because the entire face has increased in size and changed in position during the time treatment was carried out. But what counts in this instance are the differences which appear between the first and last measurements when taken in the same way.

I wish to conclude my remarks with the warmest appreciation of Dr. Hrdlička's contribution. It is always stimulating and refreshing to hear him comment on our scientific efforts.

*Lantern slides were shown of the casts and faces of the cases referred to in the discussion, but for the sake of economy the illustrations are omitted now.

POSTGRADUATE ORTHODONTIC EDUCATION

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Head of the Orthodontia Department, New York University, College of Dentistry

THE profession at large seems suddenly to have become aware of the change in the trend of postgraduate teaching, particularly as it applies to the teaching of orthodontics. As a matter of fact, there has been no sudden change in the attitude either of the universities or of the men practicing the specialty. The need for a thorough training has been realized for a long time, and at various times attempts have been made to set a minimum standard for specialization. These attempts have always failed, but they were of material advantage in that they did make the universities conscious of the obligation that they owed to the profession. We at New York University have made a definite attempt to meet the demands and we have set a standard in our postgraduate teaching that will, in our opinion, raise the standard of the specialty.

The course covers a minimum of two years, but to date we have been fortunate in maintaining a four-year training. In the near future we shall make the four years' training obligatory. At the present time, the second two years are optional, but thus far we have found that the men are all very eager to take advantage of the opportunity which is offered them.

The four years are graded very much the same as are the four years in the undergraduate school excepting that each collegiate year consists of eleven months. The result is that the student gets the equivalent of five and one-half academic years. We have a trained permanent staff that acts as a nucleus, and the postgraduate men revolve about this permanent staff. During all this time the men are given the opportunity to do all phases of the work under the supervision of trained instructors.

The first three months of the first year are devoted to didactic work. The men meet three mornings a week, and the first hour is used for the lecture of the day. The next two hours are used for the necessary mechanical training, during which time they are taught soldering technic, impression technic, model making, the making of appliances, a careful study of the dynamics of the appliances used, a preliminary study of the mechanics of occlusion leading up to the study of etiology. Every effort is made during this time to develop the skill and precision so necessary in the practice of orthodontics.

The remainder of the first year is spent in the clinic. The technic of impression taking, model making, and the constructing of appliances is applied to the treatment of practical cases. An instructor is assigned to supervise the work of three postgraduate students. When a case is assigned to a new man, the instructor and he carefully analyze the case and take a case history. At this time head measurements are taken by the instructor assisted

by the student. Photographs and x-ray pictures are taken. After impressions and models are made, the case is carefully studied with a view to determining the tooth movements indicated and to a detailed study of the appliance to be used in the treatment and an analysis of the dynamics of the appliance used as applied to the treatment of that particular case. The student then makes and inserts the appliance under the supervision of his instructor, who henceforth checks each adjustment of the appliance.

The requirements of this phase of the work are so exacting that it has been our observation that the student acquires little of the more fundamental problems of treatment. His entire attention is taken up by the mechanical phase of the treatment. We may, therefore, safely divide the first year into two separate parts: the first part, didactic, the mechanical training necessary for the proper making of models and appliances; and the second part, the application of the mechanical principles learned to the treatment of actual cases.

Throughout the entire first year, the biologic aspects are not neglected; but, as already stated, it has been our experience that the student cannot properly absorb the entire field of the subject at the one time. So far as it is impossible to accomplish satisfactory work without a perfection of technic, we stress that phase of the subject throughout the first year.

During the entire second year, we go back and pick up the important biologic phases of the subject which were taught in the first year, but which can be studied better now because the student is no longer hampered by his lack of technical skill. The making of models and appliances and the application of the mechanical forces inherent in the appliances used have become so simple by this time that the student can now concentrate on the observations of the changes in the tissues and in the changes in the relations of the teeth. His ability to observe changes in growth is cultivated. He is taught to check these changes against the normal changes in growth, so that he may be able to evaluate those induced by treatment. For this purpose, models are made of each case at the end of each year of treatment, and the head measurements and x-ray pictures are again taken. All these data are then studied by the student in conference with his instructor and the head of the department. At these conferences, the treatment of the case is carefully checked, the changes induced by treatment are noted, and the plan of treatment necessary to complete the case is outlined.

By the time the student has completed his second year, his interest in etiology and the application of the principles of muscle training, as well as the different reactions of tissues to the applied forces, have aroused an active interest in anatomy, histology, embryology, and dietetics as applied to the problems in the correction of malocclusion. We have therefore placed the study of these subjects in the third year. Now that he is aware of the intimate correlation of these subjects with the field in which he is specializing, he is prepared to absorb a great deal more from the study of them than he could were he given these subjects in the beginning of the course. The early training he received in these subjects during his undergraduate course is

sufficient to form the background for the first two years of the postgraduate course. Only after a period of training in orthodontics can he realize his shortcomings in these fields of study. When these subjects were taught in the early part of the course, the students gained no more from them than they had in their undergraduate study of them. At this stage of their studies, we find that they are very eager to avail themselves of the opportunity to go back to these subjects to pick up the more important phases which, without a proper training in orthodontics and without the experience gained in two years on the clinic floor, they could not grasp in their earlier study of them. In the third year, some cases are ready for retention. The retainers are designed by the student with the instructor's assistance, and he then makes them and inserts them in the mouth. He is thus given an opportunity to observe his cases during the retention period, and in a number of his own cases he can observe them even after the retainers have been removed. Most of his work in the clinic during the last two years is devoted to the finishing of his cases and to the careful observation of them. Only in this way it is possible for any one to obtain a proper understanding of the possibilities and the value of orthodontics. We feel that this method is a marked improvement over the older methods employed in the short courses in which the students were permitted to observe only the most promising cases and then only at those stages that showed the most marked improvement. The student was always given the wrong idea of what could be accomplished as an ultimate result, and incidentally he was never given an opportunity to complete a case. We give him an opportunity to complete, not only the active period of treatment but also the period of retention, and in a fair proportion of his cases he has the opportunity to observe them for as much as a year and in some instances as much as two years after the retainers have been removed.

In the fourth year most of his work is already completed. His time is then divided between some research problem of his own choosing, and assisting in the clinical demonstrations to the seniors in the undergraduate course. The best means of organizing one's knowledge of any subject, and incidentally the quickest means of detecting one's shortcomings, is to attempt to teach the subject. It is for this reason that we permit the postgraduate to assist in teaching the senior students. His research work is directed by the staff, and at the completion of the fourth year he organizes his findings and presents them to the entire group in the form of a thesis. This gives him experience in methods of research and in the writing and delivering of a paper.

There were many stumblingblocks in the running of a clinic and in the postgraduate teaching of orthodontics in the past that we feel have been completely overcome by this plan. First, patients are treated by only one man throughout the entire period of treatment; this is particularly to be desired for the benefit of the patient as well as for the operator. Second, the operator has the opportunity to see his patients in every phase of treatment. Third, every case is always carefully supervised by a competent member of the staff so that the patient never suffers because of the lack of ex-

perience of a new operator. Fourth, the postgraduate student is trained in every phase of the specialty, theoretical and practical. Fifth, we have a rotating staff of operators, one-fourth leaving each year. By this system of rotation, the patients are not affected, because all cases have been completed; the average case can be completed in from two to three years. When, in rare instances, a case extends beyond four years, the instructor who supervised the case is on hand to carry the case to completion. Sixth, every graduate of our postgraduate course is given an opportunity to indulge in every phase of subject that might in any way be of advantage to the specialty, even to the extent of compiling a paper and reading it before an organized body capable of criticizing his efforts. Seventh, by the proper allocation of the subject matter, the interest of the postgraduate student is stimulated at all times.

REPORT OF TWO CROSS-BITE MALOCCLUSIONS IN THE SAME FAMILY

LELAND R. JOHNSON, D.D.S., M.S.D., CHICAGO, ILL.

A BOY, aged nine years and two months, presented for treatment December 10, 1928. His adenoids and tonsils had been removed at five years of age, but he was an abnormal breather. He had a habit of biting his fingers. The frenum labium was normal; the hygienic condition of the mouth was fair; and his general health was good. (Fig. 1.)

Both maxillary and mandibular arches were narrow. A deep overbite was present, the mandibular incisors almost touching the soft tissue lingually to the maxillary incisors. The median line had shifted approximately 2 mm. to the left in both arches. The mandibular canine, first, and second deciduous molars, and first permanent molar on the left side were in extreme linguoversion and all occluded lingually to the maxillary teeth. The mandible was distal in its relation to the maxilla.

The x-ray examination, which consisted of a full mouth examination and a stereoroentgenogram of the maxillary incisor region, revealed all teeth apparently present, as well as the presence of a small supernumerary tooth to the left of the midline and lingually to the maxillary left central incisor (Fig. 2). The supernumerary tooth was extracted before orthodontic treatment was begun.

Etiology.—To me the etiology of this malocclusion is more or less obscure. The linguoversion of the mandibular molars on the left side probably occurred at the time of eruption, but I do not know why. As an interesting sidelight, however, I might add that the brother, ten years younger, had the same type of cross-bite, but on the opposite side.

Treatment.—A labial arch with a lingual extension on the right side was placed on the mandibular arch. Force was applied April 2, 1929. A vulcanite bite plane was used to depress the mandibular incisors and to remove interference to the buccal movement of the mandibular left first molar. Six weeks of treatment brought the left mandibular molars into a position of mechanical advantage. The inclines on the mandibular left first molar swaged crown and on the maxillary and mandibular left second deciduous molars were ground to remove points of interference, and the exercise for the masseter and temporal muscles was given. The case was then put on retention while the patient left the city for three months.

Upon his return labial arches were placed, and reciprocal force was applied to align the maxillary incisors. At this time an exercise was prescribed to develop the orbicularis oris.

Presented to the American Board of Orthodontia, and released by the Board to be read at the Thirty-Third Annual Meeting of the American Society of Orthodontists, New York, N. Y., April 30, May 1, 2, and 3, 1935.

January 2, 1930, the arch form was considered satisfactory, and a lingual appliance was placed on the mandibular arch and intermaxillary force applied. The intermaxillary elastics were worn on both sides until June 6. He was then advised to wear an elastic on the left side only, and elastics on both sides during the night. An exercise to lengthen the upper lip was added and soon the elastics were gradually discontinued. March 16, 1931, the arch relation was considered satisfactory (Fig. 3), and the maxillary labial arch was removed. Subsequent appointments showed that the maxillary lateral incisors had no tendency to move; so the case was placed on retention, using a fixed removable lingual retainer on the mandibular arch only.

Fig. 1. Fig. 2.

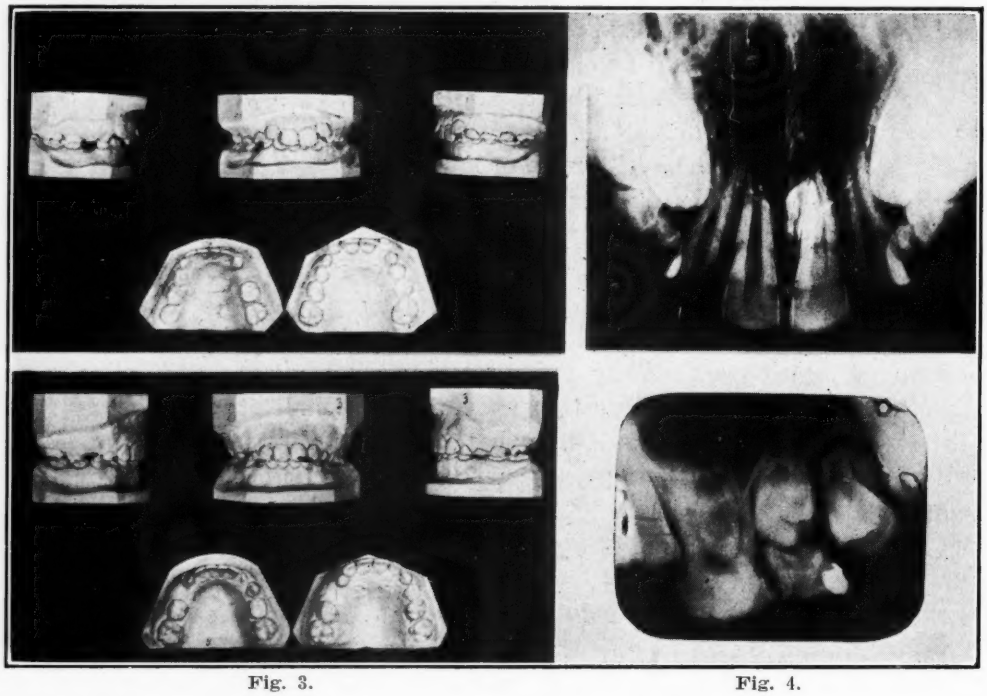

Fig. 3. Fig. 4.

The extraction of the deciduous teeth was carefully advised throughout retention.

The maxillary right first premolar was slightly mesial to its normal position, and an x-ray examination (Fig. 4) revealed that it was being held in this position by the mesiobuccal root of the maxillary right deciduous second molar. The deciduous molar was extracted and found to have an unusually wide divergence of the roots (Fig. 5).

The retaining appliance was worn one year and was removed March 8, 1932. A full mouth x-ray examination (Fig. 6) was then made, which revealed a healthy and apparently normal development. The maxillary left first premolar (Fig. 7) was being guided into its proper position by the force of the inclined planes of the first premolars, but some doubt was felt in regard to the position of the maxillary right first premolar. No improvement was noted in its position during the next two months; so a labial arch with an auxiliary

spring to move the maxillary right first premolar distally was placed May 2, 1932. One month of treatment accomplished the desired movement (Fig. 8), and the appliance was removed June 6, 1932.

The patient was instructed to continue the masseter and temporal muscle exercise in the hope that improvement might be gained. The occlusion may be said to be satisfactory, and the prognosis should be favorable.

Early in the treatment of this case, while attending the patient in his

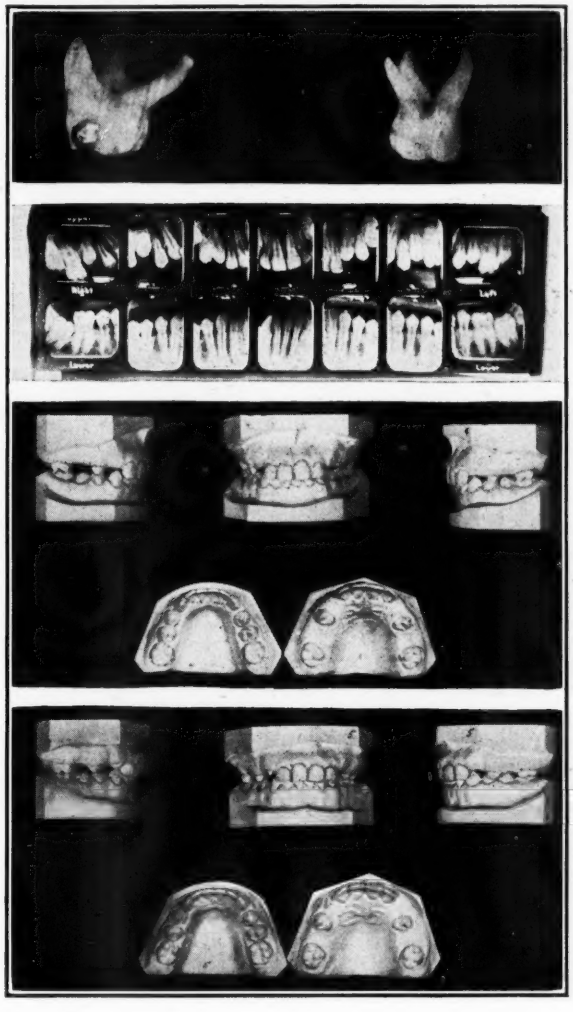

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

home, an examination of his younger brother, then approximately one year of age, was made. The four maxillary incisors were in correct alignment (Fig. 9), but the mandibular central incisors were in labioversion and the mandibular lateral incisors were in linguoversion. The maxillary incisors occluded in a line which passed lingually to the mandibular central incisors and labially to the mandibular lateral incisors. The child had formed the thumb-sucking habit. In an attempt to intercept this malocclusion, instructions were given not to break the thumb-sucking habit.

The child was next seen when he was three years and nine months of age

(Fig. 10). The malocclusion in the incisor region had corrected itself, but a cross-bite malocclusion with extreme linguoversion of the mandibular right deciduous molars had developed. The lingual cusps of the maxillary right molars occluded at the gingival of the buccal surfaces of the mandibular right molars. Immediate treatment was advised but not begun.

The x-ray examination revealed two supernumerary teeth lingually to the maxillary central incisors. Their removal was contraindicated because of their close proximity to the central incisor tooth buds. Their positions were such that probably no interference would be encountered by the erupting permanent central incisors.

Etiology.—A statement of the etiology of this malocclusion can be only conjecture. Perhaps the cross-bite developed at the expense of the correction of the malocclusion in the incisor region. There is, however, one significant fact that should be worthy of consideration. This is that there are two chil-

Fig. 9.

dren in this family, both having a similar cross-bite malocclusion, but on opposite sides. Both boys also have supernumerary teeth in the maxillary central incisor region. In one case one supernumerary, in the other case two. The occlusion of the parents can be said to be normal. There is no history of supernumerary teeth in their dentures. The question which arises is: was there a hereditary influence in the children's malocclusions, or is it merely coincidence?

Treatment.—The patient was next seen eight months later at the age of four years and five months (Fig. 11). There had been very little if any change in the malocclusion. Labial arch wires with lingual extensions on the left side were placed on both arches. A hook was soldered on the lingual surface of the mandibular right anchor band and one on the buccal surface of the maxillary right anchor band for the application of intermaxillary force. It was impossible to keep the mandibular right anchor band in place because of the occlusion, and it became necessary to abandon this plan of treatment. A cast overlay (Fig. 12) was made to cover the maxillary left canine and deciduous molars. It was built to open the bite an amount sufficient to permit clearance of the molars on the right side. A labial arch was used on the maxillary arch and a labial arch with a lingual extension on the left side was used on the mandibular arch. In both arches the canine and deciduous molars were used as anchorage units to control the movement of the opposite side. Numerous delays occurred, and force was not applied until March 27, 1933. Force was applied by the labial arch in a buccal direction on the mandibular right second deciduous molar only. This was continued for three months, and active treatment was completed June 27, 1933. It was not necessary to apply force to the mandibular deciduous right first molar because it followed

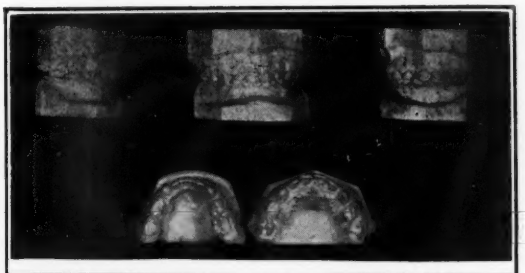

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

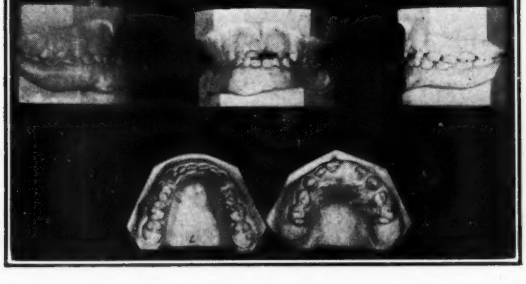

Fig. 15.

along of its own accord. When the overlay was removed, the bite was open on the left side as shown in Fig. 13.

The patient left the city for three months; so it was impossible to determine how long it took the teeth on the left side to come back into occlusion. Fig. 14 shows the occlusion to be normal when the patient returned three months later. These models also show the retaining appliance, which consisted of a fixed lingual arch on the mandibular arch. The retaining appli-

Fig. 16.

Fig. 17.

Fig. 18.

ance was worn approximately one year and was removed June 9, 1934 (Fig. 15). The mandibular first permanent molars had erupted in normal position.

Myofunctional Therapy.—The masseter and temporal muscles on the right side were very much underdeveloped. This underdevelopment combined with the occlusion on that side caused a decided asymmetry of the face. As soon as a position of mechanical advantage had been attained, the exercise for the masseter and temporal muscles was given. Fig. 16 shows the facial contour before and after the masseter-temporal exercise was given. The photograph

to the right was made eighteen months after beginning treatment. The facial musculature shows a vast improvement. It has continued to improve satisfactorily since this photograph was made.

Prognosis.—The development of this occlusion as shown in Fig. 17 can be considered normal for the child's age at six years and seven months. Continued normal development certainly is a possibility. The prognosis of this case is favorable. Fig. 18 is one view of the last stereoroentgenogram made to check the positions of the two supernumerary teeth. They will be removed at an opportune time. They are doing no harm at present.

The concluding thought is that a much greater and more satisfactory service may be done by a short period of treatment in the early development of malocclusion than can be done by a long period of treatment later in life. In this instance of similar malocclusions two years of active treatment were required for the older boy as compared to three months of active treatment for the younger boy. It is my opinion that the end-result developed normally after early treatment will be infinitely more ideal than that obtained in an attempt to correct a malocclusion after it has become an established deformity.

GROWTH OF THE JAWS AND THE ETIOLOGY OF MALOCCLUSION

ALEXANDER SVED,* B.S., D.D.S., NEW YORK, N. Y.

(*Continued from page 1017, November*)

CHAPTER IV

THE CHANGES IN BONE DURING GROWTH

The studies of Brash deal with sites of bone deposition and absorption during growth. The method employed is that of "vital staining," which consists of feeding experimental animals with food which contains active coloring principles or agents. These agents have the property of more or less permanently staining certain structures, such as bone. During the administration of such food the entire bone is affected, but the growing parts are much more deeply stained.

Using this method Brash conducted a series of experiments on pigs, which were fed on a diet containing the ground roots of the madder plant (*Rubia tinctoria*). This is a climbing perennial with whorls of dark green leaves and small, yellowish cross-shaped flowers. Its staining properties are due to two main coloring principles, alizarin and purpurin, the latter being the more powerful.

The bones of the experimental animals were colored red by the diet, but deeper in the growing parts. With this direct method, however, since the old bone was also colored, the line of demarcation was not particularly sharp, and it was found that better results could be obtained by the indirect method, which consists of feeding the animals with madder from the time of birth, and then discontinuing for any period during which growth is to be observed. Any excess of madder in the circulation is rapidly eliminated, principally by the kidneys, and the new bone laid down during the non-madder period remains uncolored, and is thus marked off very sharply from the previously colored bone.

In these experiments the indirect madder method was used. On account of the sharpness of the transition from red bone to new white bone, the growth increments during any period could be more accurately measured. The measurements were made still more reliable by selecting for the experimental animal the pig, which possesses sufficiently large bones to enable the observer to distinguish easily between the different areas of growth. The use of the indirect method brings up certain questions which may affect the final conclusions. It may be argued that the bone continues to be colored for a short time after the madder has been withdrawn on account of the presence of madder in the circulation. This undoubtedly occurs, and while the exact time necessary for the

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elimination of circulating madder is not known, it certainly is very short; otherwise the line which separates the new bone from the old bone would be more indefinite, and instead of a sharp line of demarcation a gradual gradation from red to white would take place. On the other hand, even this slight discrepancy is partly, if not completely, compensated for by a very thin pellicle of feebly stained bone, observed in the growing areas of animals killed during the madder period. This is incompletely calcified bone formed during the madder period, but its calcification is completed after the madder has been withdrawn, and its staining continued by the madder still present in the circulation. Another source of difficulty is that, owing to the amount of absorption proceeding all over the skeleton during its growth, some of the madder already deposited in the bones is set free into the circulation, and this appears to be sufficient, in spite of rapid elimination, to impart a very slight creamy tinge to the new bone as it is laid down. But this tinge is never sufficient to interfere in the slightest with the sharp line of demarcation between maddered and non-maddered bone; it is of no importance whatever, so far as the interpretation of measurement is concerned.

In considering the general principles of bone growth demonstrated by the madder method it must be remembered that the growth of bones in size by the interstitial deposit is not shown by this method, although interstitial changes, by deposit and absorption, undoubtedly occur. Thus compact bone may be changed to cancellous bone, or the process reversed without the least effect upon the space occupied by the particular bone. Apart from the ossification of the cartilage, in such situation as the epiphyseal lines, articular surfaces or the synchondroses of the base of the skull, all increase in the size of bones, or in the thickness of any part of them, is due to the deposit of new bone on their free surfaces either externally or internally. All changes in the shapes of bones, as well as the retention of form by the maintenance of the relative position of different points as increase in size takes place, are due to a combination of *surface deposit* and *surface absorption,* which in all parts of the skeleton proceed simultaneously. By the indirect madder method the surface deposition is definitely indicated throughout the entire skeleton, but the points of absorption are not always easily located. In the study of the growth of the alveolar bone, however, it is possible to locate the points of surface absorption with more or less exactness. From a large number of experimental animals Brash arrived at the conclusion that both the mandible and the maxilla grow by surface deposition and surface absorption. The growth of the alveolar border is almost wholly responsible for the increase in the depths of the bodies of the jaws. The growth of the lower border of the mandible contributes little to the increase in depth. It was also found that additions to the alveolar bone are the greatest in the incisal region and become gradually less toward the posterior teeth, and in general the process of alveolar bone deposition takes place twice as rapidly in the mandible as in the maxilla. The relative rates at which these processes take place are important to remember, for they point the way to a better understanding of the etiology of dental irregularities.

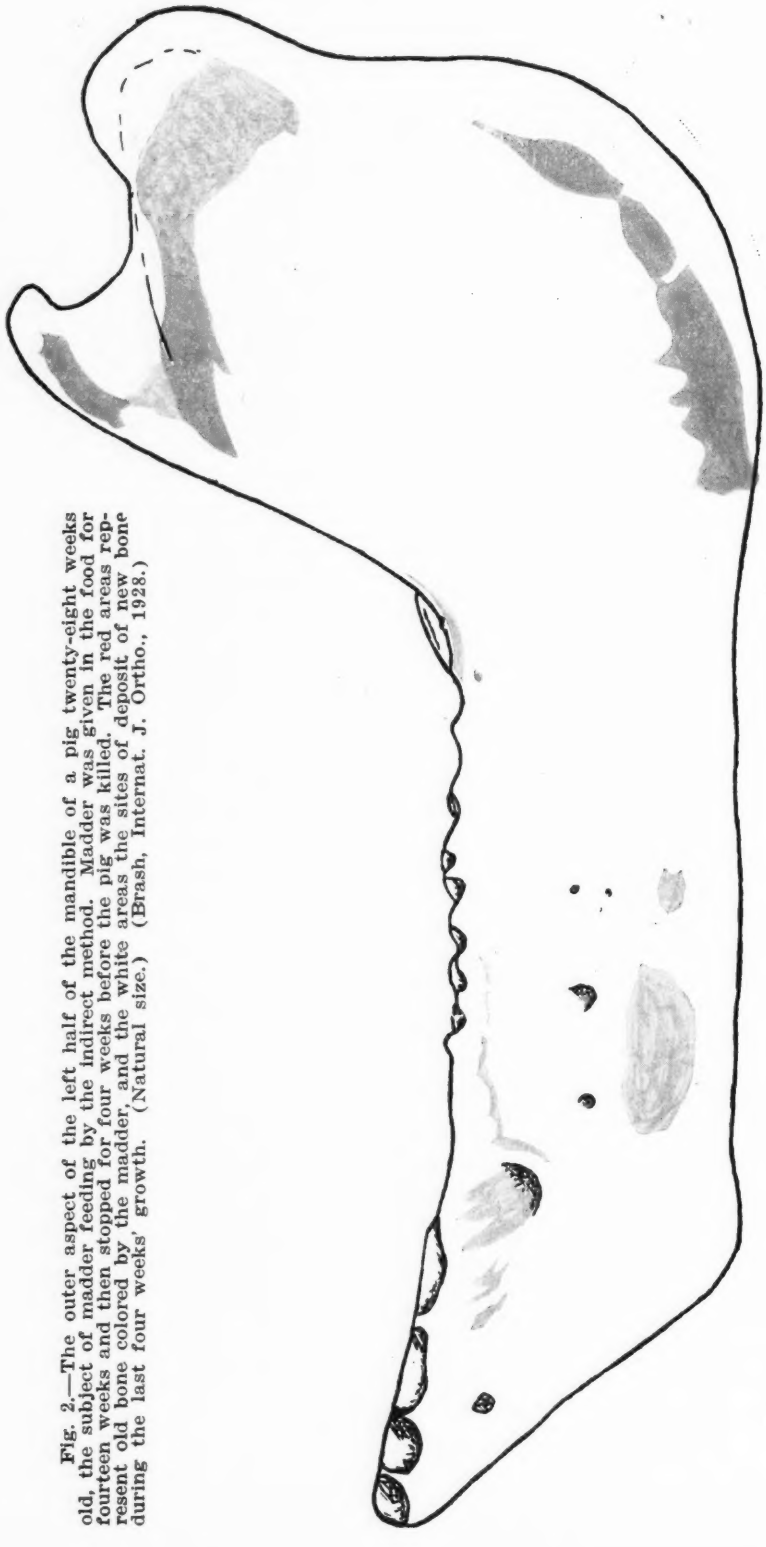

Fig. 2.—The outer aspect of the left half of the mandible of a pig twenty-eight weeks old, the subject of madder feeding by the indirect method. Madder was given in the food for fourteen weeks and then stopped for four weeks before the pig was killed. The red areas represent old bone colored by the madder, and the white areas the sites of deposit of new bone during the last four weeks' growth. (Natural size.) (Brash, Internat. J. Ortho., 1928.)

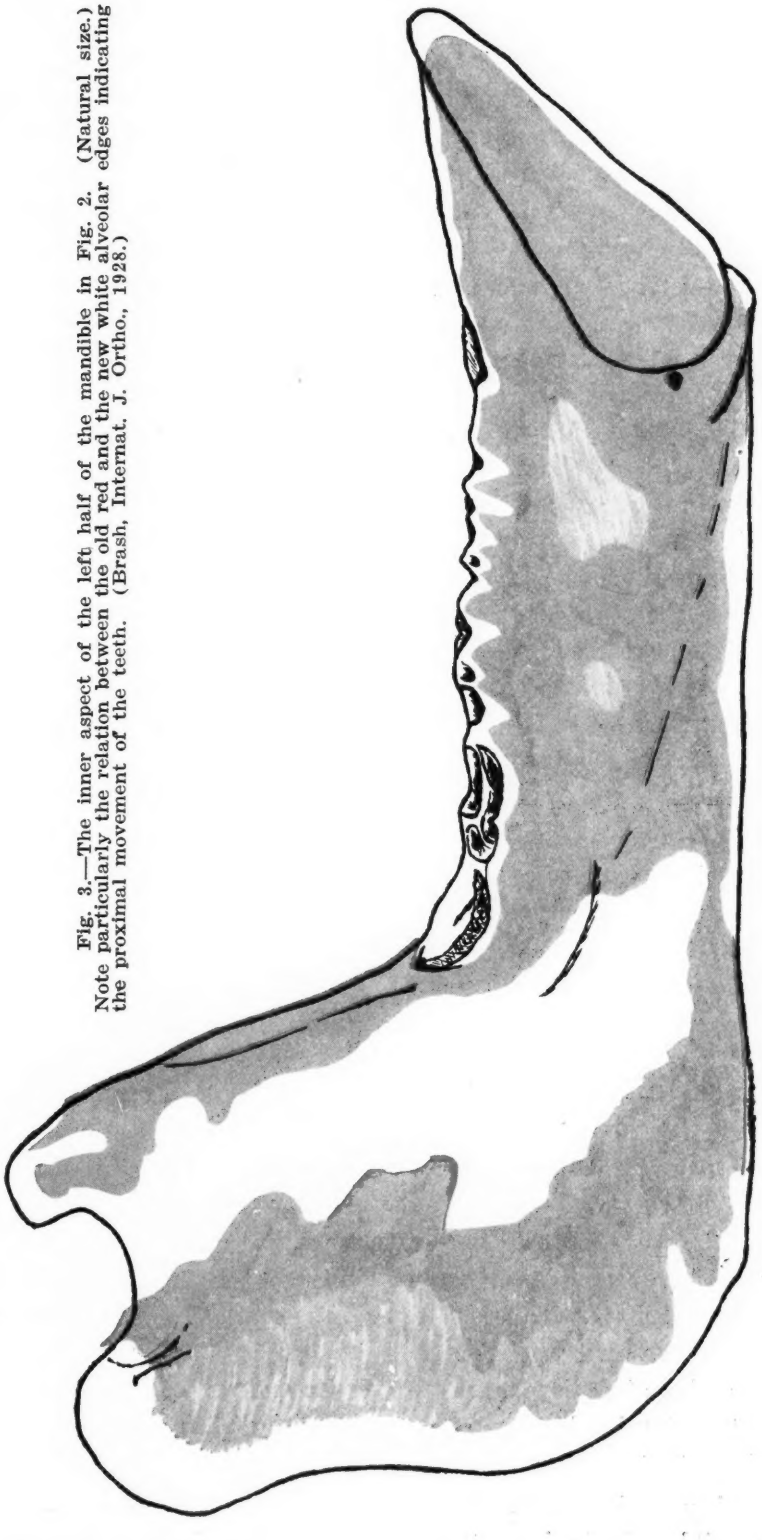

Fig. 3.—The inner aspect of the left half of the mandible in Fig. 2. (Natural size.) Note particularly the relation between the old red and the new white alveolar edges indicating the proximal movement of the teeth. (Brash, Internat. J. Ortho., 1928.)

The deposition of bone is clearly shown by Fig. 2, which represents the outer surface of the left half of the mandible of a pig twenty-eight weeks old, the subject of madder feeding by the indirect method. Madder was given in the food for fourteen weeks and was then stopped for four weeks before the animal was killed. The red areas represent old bone colored by the madder, and the white areas the sites of deposits of new bone during the last four weeks of growth. Thus, new bone covers almost the entire outer surface of this mandible. The inner aspect of the same mandible is shown in Fig. 3. Here it will be observed that there is a good deal of old bone present. The additions of new bone are found on the lingual surface and posterior border of the ramus and along the entire alveolar border. There is a labial deposit and a slight addition to the lower border, which in many animals was so small that it could be entirely neglected. The presence of white bone always indicates a deposit of new bone. Colored bone, on the other hand, may represent an inactive surface or one on which absorption takes place. From the knowledge that the mandibles of all growing animals increase in width we may conclude that the red areas observed on the lingual surface of the mandible represent areas of absorption; so that in general it may be said that the mandible increases in width by additions of bone to its outer surface and absorption on its inner surface. The length is increased by the bone which is deposited on the posterior border of the ramus and the entire condyle, the cutting back of its anterior border, and also by labial additions.

The increase in depth is brought about mainly by additions to the alveolar border. As these changes progress there must be a simultaneous rearrangement of the entire inner substance of the bone. The mandibular dental canal must alter its position in accordance with these changes, and there is evidence that this does take place.

The measurements of additions of new bone to the alveolar border of the maxilla, leading to an increase in its height, are more difficult than in the mandible. There are two reasons for this. In the first place, the rate of growth in this direction is not so great in the pig; and, in the second place, the downward increment is marred to a considerable extent by the comparatively large outward growth. The measurements of Brash, however, indicate that the maximum alveolar growth occurs in the anterior region with a gradual diminution toward the posterior teeth. Furthermore, there is sufficient conclusive evidence that the growing edge of the maxilla is the alveolar border, as was also found in the mandible. Thus, in its growth, the maxilla as a whole does not partake in a downward movement in relation to other bones of the skull, and the alveolar edge alone is responsible for increments in depth. The continual growth of the alveolar border is accompanied by a transformation of alveolar bone into bone that makes up the body of the maxilla or the mandible.

"Summing up, it may be said that the growth of the alveolar bone is of the greatest, possibly of sole, importance for the general increase in height of both the mandible and the maxilla. In the pig it is in this respect relatively more

important in the mandible than in the maxilla, since the chief growth directions in the face are forward and backward to elongate the snout. In the human skull, on the other hand, the relative importance is almost certainly reversed, since here the chief growth direction is downward. This conception agrees with the observed facts in the human skull of the developing relation of the alveolar bone to the orbit and the extension of the antrum between them.'' (Brash.)

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(To be continued)

A CONSIDERATION OF SOME PHASES OF SUPRACLUSION OF THE INCISORS*

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I HAVE been prompted to take up a consideration of supraclusion of the incisors, not because I have anything new to offer, but because there is so little definite information on the subject and because a review of the literature will be a real help, to me at least, as a basis for further study. It is a condition that is encountered in all phases of dentistry as well as in all orthodontic practices, yet one in which the etiology is vague, the diagnosis difficult, and the treatment mostly empirical.

Strang in his recent *Text-Book of Orthodontia* says, "Excessive overlapping of the upper and lower incisor teeth is a condition that occurs in all three classes of malocclusion, but is a symptom that has caused so much trouble in the past and is apparently so superficially understood by the average orthodontist that the author feels justified in devoting a portion of a chapter in this text to its analysis."

Supraclusion has been defined as denoting teeth that are elevated above their normal position or, applied to the incisors, as indicating the same condition as excessive overbite. If we consider supraclusion in relation to the anterior teeth of either the mandible or the maxilla, according to the first definition we must determine their elevation above the normal by comparison of their height in proportion to the development of their supporting bone or of that portion of the face. An excessive overbite may be an indication of supraclusion of the anterior teeth of the mandible or maxilla or both; it may, on the contrary, however, indicate an infraclusion of the molars and premolars of one or both arches. According to the classification of Howard, conditions of supraversion and infraversion may be described in four divisions.

1. A deep overbite of the incisors caused by a deficiency in vertical height of the molars and premolars; facial length abnormally short.
2. A deep overbite of the incisors caused by an excess vertical eruption of these teeth; facial length normal.
3. An open-bite of the incisors caused by an excess vertical height of the molars; facial length abnormally long.
4. An open-bite of the incisors caused by an arrestment of vertical growth in this region; facial length normal.

As to what constitutes an abnormal overbite, opinions differ. An overbite has been considered normal when the mandibular incisors strike within the middle third of the palatal surfaces of the maxillary incisors in centric occlusion; when it varies within the range from an edge-to-edge bite to an overlap of one-tenth inch; when it is the same as the height of the maxillary

*Presented to the American Board of Orthodontia.

premolar cusps. Wallace has written, and many observations support his statements, that there is a general forward movement of the mandible and the mandibular teeth in relation to the maxilla and the maxillary teeth throughout life commencing with a distal relationship of the gum pads of the newborn child which is overcome as the mechanics of nursing demand a forward thrust of the mandible, continuing with a slight overbite in the early deciduous denture, becoming gradually an edge-to-edge bite as the deciduous cusps are worn flat and the forward movement continues, and progressing in the same manner with the permanent dentures which in early adult life again show somewhat of an overbite due to the combined mesiodistal diameters of the permanent mandibular premolars and canines being less than those of the teeth they replace, and again returning to an edge-to-edge relationship as wear takes place over a period of years.

If that is the ideal, then under such conditions the edge-to-edge bite must be considered within the range of normal. Still, while it may be ideal, it is by no means constant, and modern ways of living tend to produce less and less cuspal wear. It has also been demonstrated that the amount of overbite tends to vary with the type of arch—the broad square arch approaching more nearly the edge-to-edge bite while the narrow arch presents more anterior overlap—and as we consider the various types of arch form within the normal, so must we consider the varying depth of overbite. What, then, may be considered the limit of normal depth? In considering balanced occlusion in edentulous cases, the prosthetist knows that, allowing for the slight variation permitted by the amount of overjet and the degree of the curve of Spee, an anterior overbite greater than the height of the premolar cusps will upset the balance and trip the denture. In like manner, in dentulous mouths a greater overbite may cause definite trauma. Can we not say with reason, then, that the limits of normal overbite are an edge-to-edge relationship and the height of the maxillary premolar cusps? Any overbite within these limits is normal. It follows that any overbite in excess of these limits is abnormal.

That excessive overbite is a common condition is apparent to anyone examining many cases of malocclusion. It may be associated with any one of Angle's three classes of malocclusion. It may occur at any age in either the permanent or the deciduous dentition. Of the total number of cases under treatment in the graduate clinic of Harvard University Dental School, 45 per cent show an excessive overbite, measured by the standard determined above; of these, 30 per cent have neutroclusion (Class I); 68 per cent distoclusion (Class II); 2 per cent mesioclusion (Class III). Fifty per cent of the patients with deciduous dentition have excessive overbite; while those with permanent dentition have it to the extent of 44 per cent. The depth varies from what has been accepted as the limit of normal to a condition in which the mandibular incisors and some of the investing tissues disappear from sight behind the maxillary incisors upon closure of the jaws and severe irritation has been caused to the mucous tissues palatal to the maxillary incisors by the impingement of the mandibular teeth. The areas are reversed in those cases associated with Class III malocclusion.

Of the etiology of this condition, as of that of so many other phases of

malocclusion, little is definitely known. For purposes of examination I have divided the possible causes into intrinsic factors (i.e., factors operating within the dental apparatus itself) and extrinsic factors (i.e., factors operating outside of the dental apparatus). In this connection several quotations from Brash's first lecture on "The Aetiology of Irregularity and Malocclusion of the Teeth" are very apt. He says, "Without entering into any discussion of the philosophical aspect of causation, of the nature of succession and necessity, we must at least take note of the need to distinguish clearly between a 'cause' and a 'factor.' It is abundantly clear that irregularity and malocclusion of the teeth are not in the least likely to be found to depend upon a single 'immediate cause'—a great many 'factors' may have to be taken into account to explain fully even the simplest case." Again, "Putting aside irregularities which are strictly outside the main problem—such as are due to excess or deficiency in the number of the teeth and other purely local causes—it may be said with certainty that no hypothesis has ever been put forward which has not subsequently and frequently been denied; and if it is not true to say that all have been disproved, yet it is certain that not one has been established." And making a distinction between hypothesis and speculation, "A hypothesis may arise out of speculation, but it is something which has to be verified by methodical observation and experiment until, if it succeeds in ousting competing hypotheses, it may rise to the rank of a theory. It is not merely to be asserted and repeated again and again until it becomes a matter of belief, on the principle that what we are told three times must be true."

The outstanding intrinsic factor in the causation of supraclusion of the anterior teeth is undoubtedly lack of definite occlusal contact. This has been demonstrated again and again in many types of cases, and only a few of its methods of operation need to be mentioned. In neutroclusion cases it occasionally appears in the deciduous dentition where there is crowding of the mandibular teeth and in the rare cases of complete linguoversion of all the mandibular teeth. Shortly after or during the transition to the permanent dentition it occurs in those cases in which there has been a break in the mandibular arch from the loss of a tooth or the tardy eruption or impaction of a permanent tooth. The process is begun by a distal drifting of the mandibular incisors usually accompanied by a distal inclination of their crowns. Posterior support being lost, the mandibular incisors are forced distally by the lingual inclined surfaces of the maxillary incisors and continue to erupt until in contact with the palatal tissue. At the same time the maxillary incisors, deprived of occlusal support, erupt downward and are often forced labially from pressure of the mandibular teeth on the height of their lingual contour. Another typical condition producing supraclusion of the anterior teeth in neutroclusion cases is that caused by a pressure habit that forces the maxillary incisors labially and in that manner removes the proper occlusal support of the mandibular incisors.

In distoclusion cases the condition is so common as to be called characteristic. It occurs in both the deciduous and permanent dentitions. Eby speaks of supraclusion in Class II cases of the deciduous dentition and mentions Gunton's models as showing its progress in early cases of developing

distoclusion. "The majority of these cases evidence early signs of deep overbite, a leaning inward of the mandibular teeth, a certain locking effect in the occlusion and the first natural tendency toward retarding the development of the mandible." That the condition is not universal in this type of case can be readily demonstrated, however, and indicates that there are other factors involved than merely the lack of occlusal support. In some individuals supraclusion never develops, in others it appears late in life along with general shifting of the teeth from occlusal stresses or natural growth tendencies. Whether or not this difference is due to the amount or manner of use of the teeth during mastication is a matter that is open to investigation. DeVries says, "There is no doubt in my mind that hypofunction plays a most important part both in the production of this type of malocclusion and in the maintenance of relationships after supposedly successful treatment."

In mesioclusion cases the supraclusion of the incisors is much less frequent, probably owing to the fact that many cases of this type are associated with a disturbance in growth tendencies. Instances are not infrequent, however, in which the same factor, lack of occlusal support, works in the same manner, and supraclusion of either mandibular or maxillary incisors or both results, the overbite often being so great as to hide completely the maxillary teeth from view.

While the intrinsic factors mentioned above are well supported by clinical evidence, those factors which may be called extrinsic in the etiology of supraclusion of the incisors rest mainly in that hazy borderland between speculation and hypothesis if they are not entirely in the realm of speculation. There are those cases appearing early in life, before the fourth year, that exhibit an extreme supraclusion, usually of the maxillary incisors, that can in no way be explained merely by lack of occlusal balance. Korkhaus states that there is a "predominating hereditary influence" in cases of excessive overbite. He says, "Just as in the case of the mandibular protrusion, so does the excessive overbite give a clear suggestion of inheritance. In nearly all cases identical twins showed absolute conformity. With non-identical twins, however, a different appearance could almost always be noted."

In a chart of three generations he found the following condition: of a family of four children, the two girls had excessive overbite, one boy had an abnormal frontal overbite, the other boy had a normal overbite; the mother, one of a family of five, had an excessive overbite, one sister and two brothers had the same condition, the overbite of the remaining sister was normal; the one daughter of the normal sister and the son and daughter of one brother were all normal; the grandmother had an excessive overbite and the grandfather was normal. While this is an extremely interesting study, so many other factors may be involved that a considerable amount of additional evidence will have to be accumulated to place heredity definitely as a cause. Korkhaus recognizes this in stating that, ". . . . the assumption is based upon relatively few cases."

That some growth factor is involved, however, seems apparent. In one of the round table discussions at the meeting of the American Society of Orthodontists in 1929 the question of hypertrophy of the premaxilla was

brought up. The question propounded was "Do you think in some deciduous cases there is not only a supraclusion of the mandibular anterior teeth but also a dropping down of the premaxilla?" Of the six men at the table five thought there was, one was not sure. Brash states that there can be no growth in the sense of separation at the premaxillary-maxillary sutures on the palatal aspect, even when those are very evident, since they are only the remains of the complete suture, the main parts of which (the facial aspect) have long been obliterated.

The possibility of surface growth, however, remains, as well as the varied rates of growth in different areas. In this connection it is well to bear in mind those cases of neutroclusion of the deciduous teeth exhibiting a deep overbite which later through growth spurts in other areas develop a normal overbite. Several of these cases have been recorded. Lewis says, "It often happens that an apparently deep anterior overbite changes to an edge-to-edge bite or even to an open-bite during the period of adjustment." (Occlusal adjustment coincident with the locking of the first permanent molars, between the sixth and the ninth years.) But he also says with regard to a Class II, Division 2, case, "In our experience these deep overbites never correct themselves." Todd states that vertical growth of the facial mask involving the face between the root of the nose and the maxillary teeth is largely respiratory in nature and occurs in spurts of which the first takes place during the six months after birth, the next during the third and fourth year, another from seven to eleven years, and the last between sixteen and nineteen years, this one being probably largely sexual. The area which includes the mandible has its own growth patterns.

It remains for such studies as those conducted by Lewis, Hellman, Broadbent, and Todd to throw more light upon the early development of these conditions and to open up more definite paths toward an understanding of their etiology.

The diagnosis of supraclusion of the incisors is often difficult. It demands a knowledge of the normal of the given physiologic age group and the range of variation within the normal, together with an interpretation of the findings in the given case in respect to this knowledge. It also requires a differentiation between similar symptoms having different causes. Thus, as mentioned before, the presence of an extreme overbite is suggestive of supraclusion but may instead be the result of infraclusion of the posterior teeth. Strang and Howard point the way to a correct diagnosis of anterior supraclusion through a combined study of models, photographs, and of the patient himself.

Many articles have been written on the treatment of supraclusion, and all types of mechanical appliances have been employed including overlays, bite planes, and the edgewise arch mechanism, with varying results. Mechanical principles have been so highly developed, however, that the questions of treatment have to do not so much with what appliance to use as with what cases demand treatment and when is the proper time to institute treatment. It seems to me from the evidence now available that those neutroclusion cases which present no other deformity and in which the overbite is not so great

as to cause damage to the soft tissues can well be held under observation until that period of adjustment described by Lewis or the third period of vertical growth mentioned by Todd is completed. On the other hand, in distoclusion and mesioclusion cases treatment should be begun to correct the occlusal relationships as soon as possible, together with the necessary reductions of the supraclusion in order that the later period of adjustment and growth will not be hindered by abnormal function.

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A CORRECTION FOR THUMB- AND FINGER-SUCKING HABITS

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THE correction of habits which are detrimental to the proper alignment of the teeth is one of the most difficult problems in orthodontia.

We all know how difficult it is for an adult to combat a habit such as smoking. How much more difficult it must be for a child with undeveloped will power to rid itself of a habit equally hard to terminate. Our attitude in these cases must be one of helpfulness; and wherever possible, I believe, mechanical aid should be utilized.

This device for the correction of thumb- and finger-sucking habits is based on the assumption that lack of suction between the thumb or finger and the roof of the mouth will break the habit.

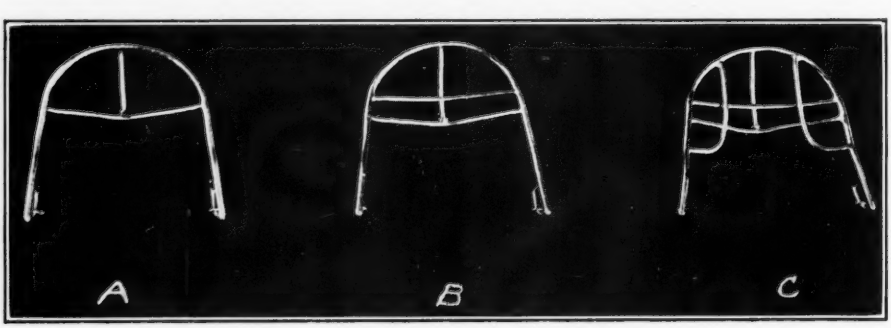

Fig. 1.

The appliance shown is a product of necessity. My own little girl at the age of two years and six months contracted the habit of sucking the first finger of either hand. All the preventive devices with which I was familiar were tried, but without permanent success.

It occurred to me that if I could place something in the roof of her mouth which would break up suction I would have the solution. My first attempt is shown in Fig. 1, *A*. Bands with half round tubes on the lingual surface were placed on the second deciduous molars. An 0.040 inch wire was adapted to the lingual surface of the teeth anterior to the second deciduous molars. Two 0.030 inch wires were placed as shown, clearing the hard palate by about one-quarter of an inch. The appliance at this stage failed to prevent suction. Another wire was added as shown in Fig. 1 *B*. Finally two more wires were added as shown in Fig. 1 *C*. Fig. 2 shows the appliance on a model. Since there was now no possibility of obtaining suction between the fingers and the roof of the mouth, the habit was definitely broken.

Clinic presented before the American Society of Orthodontists in New York, May 3, 1935.

This device has subsequently proved uniformly successful in my practice. The procedure in its use is as follows: In from ten days to two weeks after placing the appliance in the mouth the reflex to raise the hand to the mouth is gone. To make sure the habit is broken, the appliance is left in the mouth from three to four months. The framework is then removed, leaving the

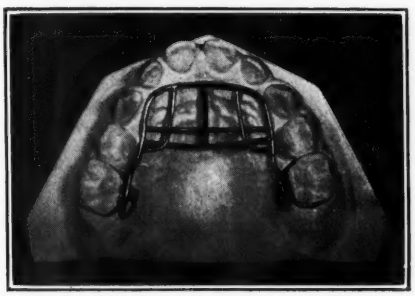

Fig. 2.

Fig. 3.—Models on left before treatment; models on right, four months after placing appliances.

attachment bands in place. If no tendency is noted to return to the habit after an additional two or three months, the habit is definitely broken.

The appliance may be used as soon as the second deciduous molars are sufficiently developed to warrant placing bands.

The ingenuity of the operator may be used in constructing this device to conform to the needs of each individual case, always bearing in mind that the

primary object is to break up suction. When advisable it may be utilized to maintain the space of a prematurely lost tooth. Occasionally we find that the sucking habit has narrowed the maxillary arch materially, as well as having carried the maxillary anterior teeth forward. In such cases (Fig. 3) it is a simple matter to add lateral finger springs which will provide width and permit the mandibular arch to come forward to its proper position. It is also advisable in these cases to align the 0.040 inch base wire considerably lingual to the four anterior teeth, thus allowing them to move lingually, which they will do when thumb or finger pressure is terminated. Nature will assist greatly in these cases when the habit is broken, but it is always well to do as much as possible to aid her.

This type of appliance is well tolerated by children. Food does not lodge to an objectionable degree. Speech is not impaired, and the youngsters evince no desire to remove the appliance. As a rule, they welcome such a device and are delighted to shift the responsibility to an appliance. This done, there is a noticeable improvement in their dispositions and a lessening of nervous tension.

There is no service an orthodontist can render which will win for him more whole-hearted appreciation from parents than the correction of a thumb- or finger-sucking habit.

MALOCCLUSION PRODUCED BY FORMATION OF SCAR TISSUE*

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THIS is a case which would be difficult to classify from examining the models alone, but, when the patient is examined, what has occurred to the denture is perfectly obvious. The patient was a girl twelve years old who at the age of four years had suffered a severe burn from a gasoline stove. The contraction of the scar tissue about the lower part of the face and neck had drawn the anterior part of the mandible downward and forward, carrying the teeth with it. The influence of this force is seen even in the molar regions; on the right side the mandibular first molar was definitely forward of its normal relation with the maxillary first molar, while on the left side both maxillary and mandibular molars had drifted downward, which accounts for the squeezing out of the maxillary left second premolar. Both arches were narrow because of the contraction of the scar tissue on the face.

When orthodontic work was first started in November, 1927, the child was a patient in the St. Agnes Hospital, a charity hospital and home for crippled children. She had had a series of operations to relieve various adhesions of the scar tissue; the last two operations had been performed by Dr. Francis E. Butler. Dr. Butler did three more operations after orthodontic treatment was started, and intended to perform more. This was prevented by his death. Of course, the major improvement in this case was due to the surgery of Dr. Butler, and not to the orthodontic work. It had been my intention to present a joint report with Dr. Butler on this case.

As can be seen from the original photographs (Fig. 1), the lower lip was pulled down so far as to eliminate the vestibule in that portion of the mouth. The saliva could not be retained by this lip, and the child had continually to wipe it from the lower lip. The result of the operation performed in June, 1924, before which time the arm had been attached to the body as far as the elbow, can be plainly seen in Fig. 1. The operations after orthodontic treatment was started had for their object further relief of the downward pull of the scar tissue, and to allow the lower lip to approximate the upper. How well this was done can be judged by the photographs shown in Fig. 2.

Orthodontic treatment extended over a period of a little more than four years. On the maxillary teeth a pin and tube appliance was placed with the first molars, first premolars, and four incisors banded. With this I intended to move the maxillary left molars back to create space for the left second premolar, and to widen the arch. Of course, the chief function of this stable appliance was to provide sufficient anchorage for intermaxillary force to the mandibular appliance. The mandibular second molars and canines were banded, and a buccal arch ran into parallel tubes on the molar bands. This

*Presented to the American Board of Orthodontia, May, 1932.

arch was stabilized by hooks on the canine bands, under which hooks the arch rested. Intermaxillary elastics were applied, and the buccal arch slid back in the parallel tubes as this action progressed.

When sufficient space had been gained in the maxillary arch for the left second premolar, and after the left first molar had been moved into its correct buccolingual relation with the mandibular, the maxillary appliance was

Fig. 1.

Fig. 2.

changed to a lingual arch with an auxiliary spring against the left second premolar. Then elastics were gradually discontinued, and the second model was made fifteen months after the removal of the mandibular appliance, but only two months after the removal of the maxillary lingual arch which had been left on as a retainer.

If retention has a place in orthodontia, and I believe it has in a number of cases, it should be used here, where not only are the tissues surrounding the dental apparatus changing of their own accord, but also surgical work is

being done to give them greater freedom. The last operation was performed in February, 1931, just a short time before Dr. Butler's death. The maxillary lingual arch was removed nine months after that.

As for the prognosis of the case, there may be some collapse of the maxillary arch, although the attempted expansion has accomplished very little. Of course, both arches are much too narrow, and the occlusion of the side teeth is so far from correct as to give grave concern for their future health, but, all results being relative, I had to be content with this one. I am not claiming

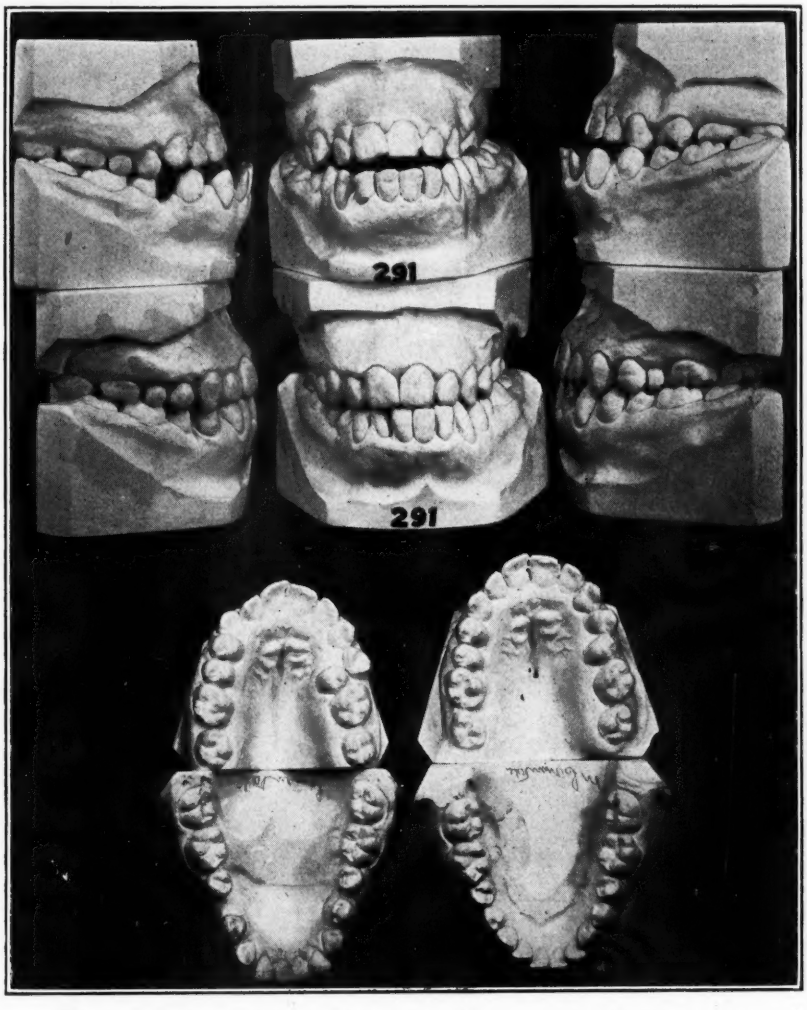


Fig. 3.—Models made in November, 1927, and in February, 1932.

that it is as good as could be obtained. Any one can see a number of improvements that could be made, with a fair degree of assurance that they would be permanent. But the child had had eighteen operations in all, four years of orthodontic appliances, and in the meantime had been discharged from the children's home to return to her parents, who live out of town. They had no money to be spent for numerous trips to my office, and so it was decided to call the case finished. The cessation of treatment in many cases is indicated by extenuating conditions, and not by the actual result obtained.

UNILATERAL DISTOCLUSION*

JOHN A. MCPHAIL, D.D.S., CINCINNATI, OHIO

THE patient presented with a linguoversion of the maxillary central incisors and the mandibular incisors, with a unilateral distoclusion. Fig. 1 shows casts when treatment was started.

Bands were attached to the maxillary and mandibular first permanent molars. Lingual wires, 19 gauge, were soldered to the lingual surfaces of both maxillary and mandibular bands. Intermaxillary hooks were soldered to the mandibular molar bands. Tubes were soldered to the buccal surfaces of the maxillary molar bands for a 0.040 inch labial arch to which were soldered hooks and stops. A Lourie wire stretcher was used to expand both dentures.

Fig. 1.

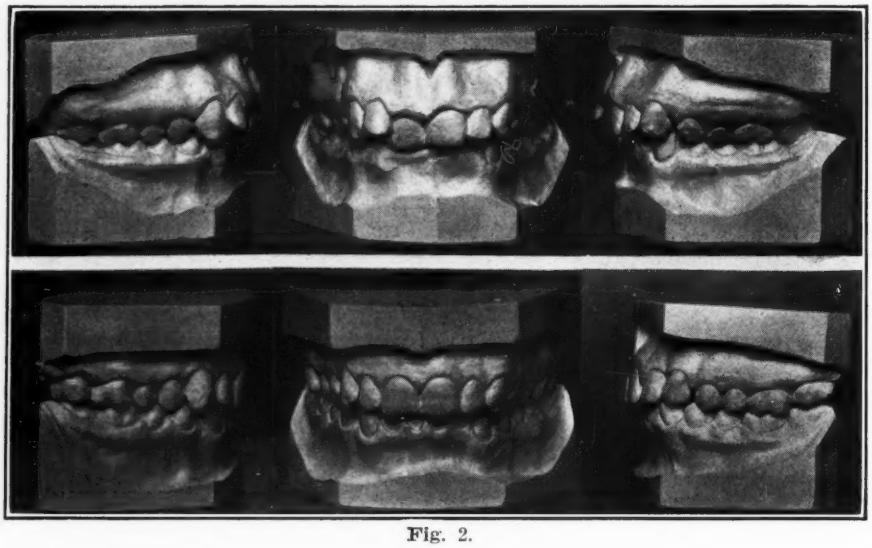


Fig. 2.

The maxillary central incisors were ligated to the labial arch. The patient was instructed in the use of the intermaxillary elastics. After sufficient expansion was secured and the maxillary central incisors were brought into more pleasing alignment, the appliances were reconstructed by replacing the lingual wires with new ones and adding auxiliary springs to the mandibular appliance.

When all the anterior teeth were brought far enough labially, and there appeared to be sufficient arch development, the case was completed by adding auxiliary springs to bring the mandibular left canine into proper occlusion. The mandibular appliance was again remodeled by changing auxiliary springs

*Presented to the American Board of Orthodontia.

and bringing the mandibular left first premolar into contact with mandibular left canine. The second premolar was brought forward in the same manner. The mandibular left second premolar was banded, and a lingual wire was soldered from this tooth to the mandibular right first molar and acted as a retainer. Intermaxillary elastics were used to bring the mandibular left first molar forward.

Fig. 2 shows casts three years after appliances had been removed. The patient has been seen from time to time for the past eight years and shows no evidence of the return of the teeth to their former positions.

INSTRUMENT FOR DETERMINING AND EQUALIZING FORCES APPLIED TO INDIVIDUAL TEETH BY ALIGNMENT ARCHES AND OTHERWISE

LANDIS H. WIRT, D.D.S., SOUTH BEND, IND.

THE application of force in orthodontic treatment has always been more or less haphazard, and limited chiefly by the fortitude of the patient.

Since studies have been made by several researchers with a view to determining what takes place in the supporting tissues during tooth movement, it has become evident that orthodontic procedures should be placed upon a more rational basis and the forces applied should be limited to what those students have indicated is the range of biologic tolerance.

Among the first to attempt to measure the amount of force to be applied to a tooth, so far as I have been able to discover, was Joseph E. Johnson, who made use of a modified postal scale for measuring the pressure required to bring an alignment wire into the bracket of a band on the tooth to be moved.

Another tension tester was introduced by J. E. Robinson; this consisted of a simple cylindrical spring scale, one end of which could be used to measure the push tension, and the other the pull tension on a wire. This device was adapted for use not only on labial alignment wires, but also on the auxiliary springs of a lingual or palatal appliance.

Neither of these devices could be depended upon to give reliable information where more than one tooth was to be attached, because with the attachment of each succeeding tooth, those first attached would have their tension increased owing to the decreased distance between the fixed points (anchor teeth) and the points of attachment of each additional tooth included.

The instrument under consideration here is designed to provide a means by which one may measure the tension to be applied to every tooth in malposition, equalizing it so that every tooth may be subjected to a similar and known amount of stress, regardless of whether it be push or pull, elevation, depression, torsion, or the power to be obtained from torque in the wire.

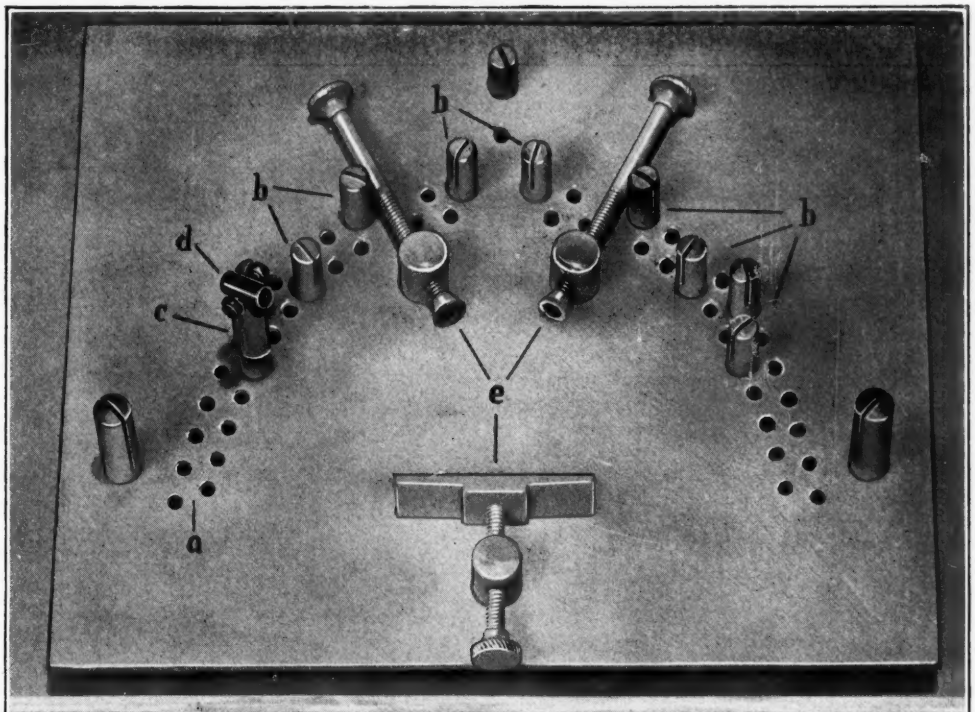
A brief description of the instrument and the mode of operation follows.

Upon a base consisting of a flat metal plate (Fig. 1) is arranged a series of threaded holes (*a*) in the general form of an arch, into which are screwed split stubbs (*b b b*) which support swivels (*c*) which telescope them and may be raised or lowered. These swivels carry friction rings (*d*) through which are passed the cylinders of the tubular spring scales, the sliding rods of which are provided with a prong at one end and a hook at the other.

Clinic presented at the Thirty-Third Annual Meeting of the American Society of Orthodontists, New York, N. Y., April 30, May 1, 2, and 3, 1935.

At a suitable place within the series of stubs a three point clamping device (*e*) is provided, to which a plaster model may be adjusted. After the necessary

Fig. 1.



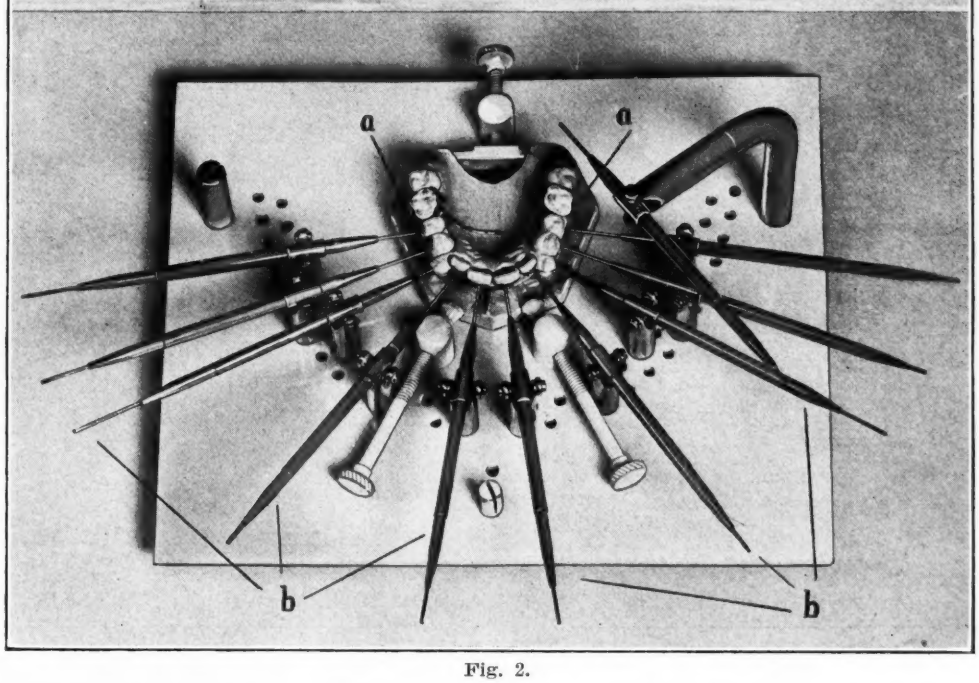


Fig. 2.

bands have been made, they are fitted upon the model and an alignment arch wire is shaped to the ideal form and the ends are inserted in the buccal tubes on the anchor teeth Fig. 2 (*a*). The scales are then adjusted on their swivel posts,

each directly opposite a tooth to be moved, with the pronged end pointing to a tooth which is within the line of normal position, and the hooked end to one that is buccal or labial to the normal line (*b b b*). Each scale is brought to bear upon the alignment wire opposite its corresponding tooth, and by sliding the barrel

Fig. 3.

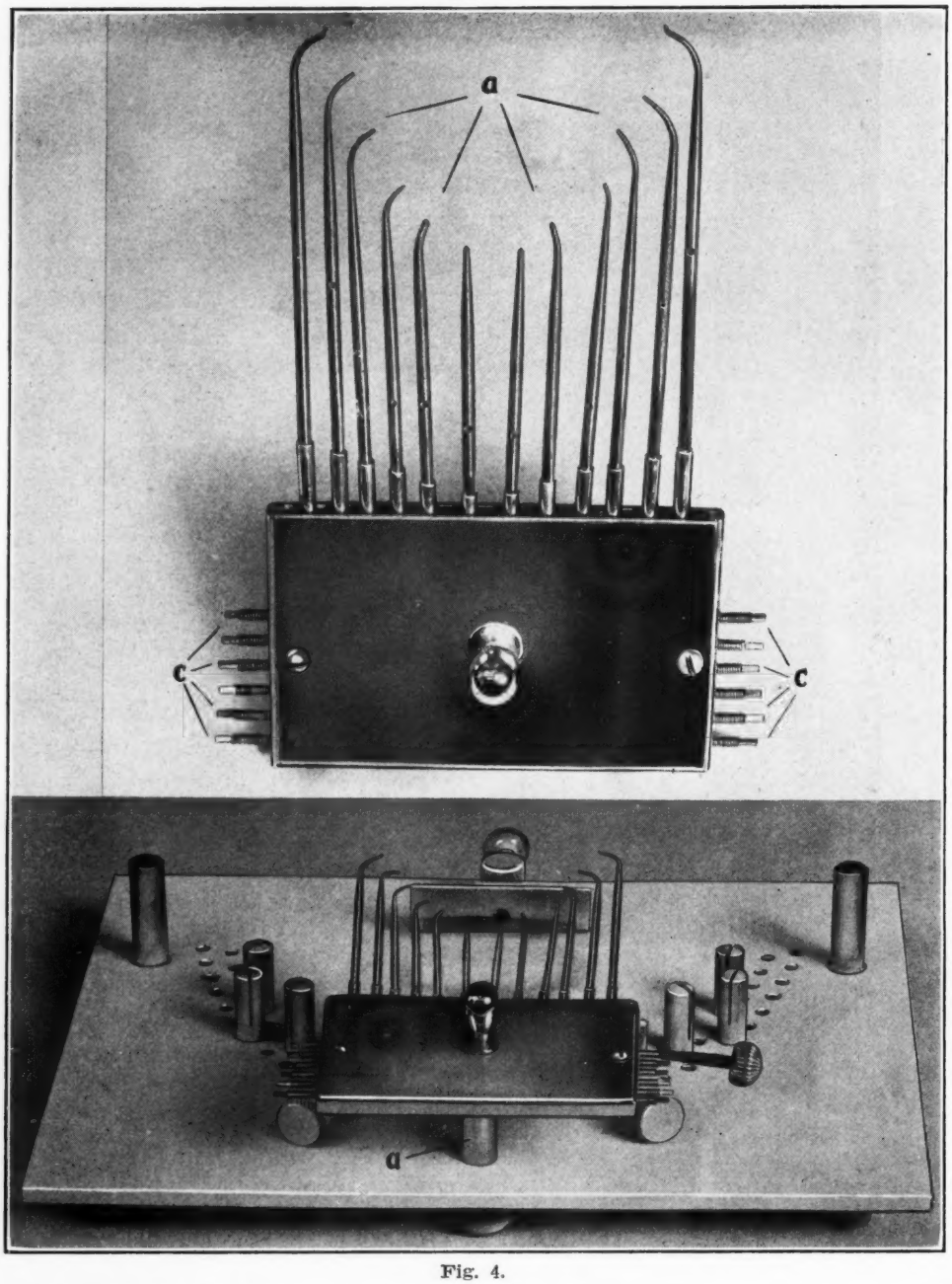
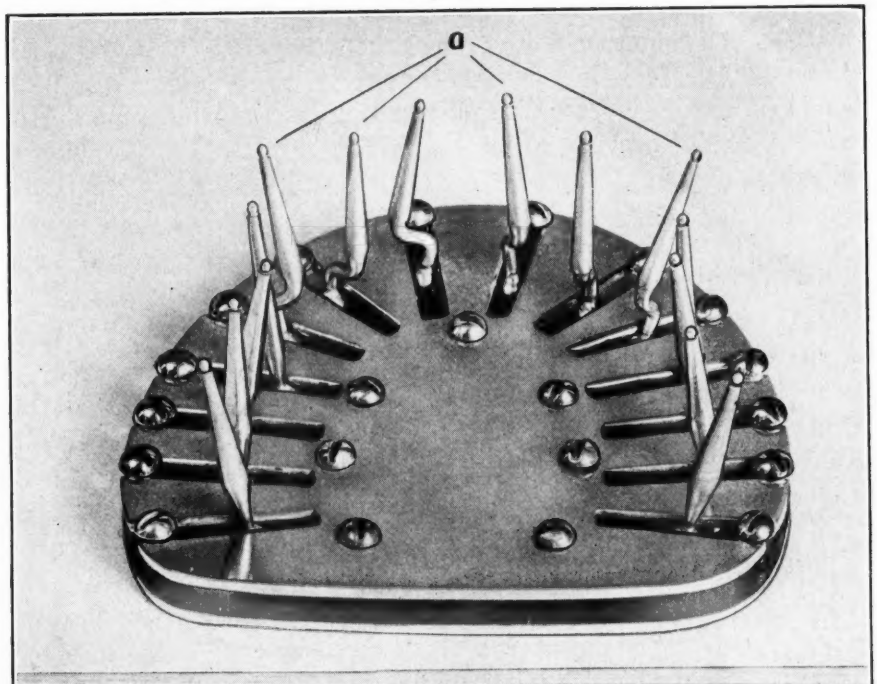


Fig. 4.

toward or away from the tooth until the desired amount of pressure is registered, one determines the amount of stress upon the wire opposite each tooth when the wire is in contact with it, and by bending the wire wherever necessary one may bring the stress to be applied to each tooth to the desired amount.

Fig. 5.



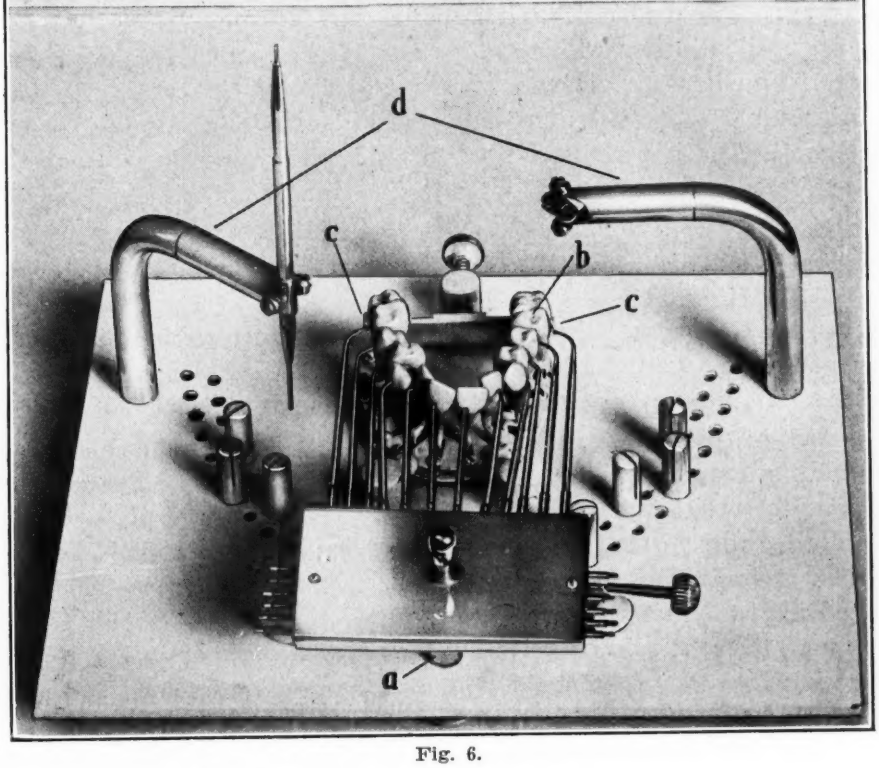


Fig. 6.

The whole appliance is then transferred to the mouth; the bands are cemented; and the alignment arch is affixed to its attachments.

When the patient returns at the next appointment, it is necessary to determine the extent of change in the position of the teeth which has resulted from the stresses applied. This is done by means of a position finder (Fig. 3), which consists of a series of twelve suitably shaped pointers (*a*) mounted on pivots and adjusted by threaded arms (*c c*), each of which is squared at the outer end to fit a socket key.

The two outer pointers are adjusted to permit their free ends to enter the buccal tubes on the anchor teeth in the mouth. By applying the key to each of the pointer arms they are adjusted laterally, and by sliding them outward or inward on their mountings, the free end of each pointer is brought to contact with its corresponding tooth at or within the band bracket.

The position finder is then removed and placed upon its mounting stub on the bed plate, Fig. 4 (*a*). This mounting, like those of the individual scales, may be raised or lowered on the post, and as it has a ball-and-socket mounting may be given any desired position relating to the horizontal plane.

At the beginning an extra set of impressions was made, the purpose of which will be indicated presently.

A duplicator (Fig. 5) consisting of an oval frame around the edges of which are mounted fourteen ball-ended pegs (*a*) representing the teeth, is adjusted so that each peg may be introduced into its corresponding tooth impression as nearly as possible in line with the long axis of the tooth. As the six anterior teeth are found in more diversified malpositions than the others, the pegs for these are made offset so that they may readily be made to assume almost limitless postures. The impression is then poured with just enough plaster to fill the coronal portion, and the duplicator is placed in position in it. Before pouring, tubes with lugs are heated and embedded in the buccal surface of the first molars in such position that when the impression is removed they will represent the buccal anchor tubes which are on the patient's teeth.

When the coronal casts have set, the impressions are removed and the teeth detached from each other and from the pegs, and the surplus is trimmed away. They are then filed away in the laboratory with the patient's name on the box.

On the patient's return, after having used the position finder as indicated above, and replacing the plaster teeth on the duplicator pegs, affixing them with sticky wax, the position finder is placed on its post on the bed plate, Fig. 6 (*a*), and duplicator with plaster teeth mounted (*b*) is placed upon the bed plate with the clamp, and adjusted so that the outside pointers of the position finder engage the buccal tubes carried by the plaster molars (*c c*). It is clamped in this position, and the other plaster teeth are then moved on their ball-ended pegs to positions in which they contact the points of the position finder. This gives the new position of all teeth that have been moved. The position finder is then removed, and the scales are mounted on the stubs.

The alignment arch is placed and given the necessary adjustments to cause the scales to register the proper amount of tension at each tooth, after which it is replaced in the mouth.

Additional posts (*d d*) to mount long armed swivels in which scales may be adjusted to vertical and other positions are provided, and thus many different applications of stress may be measured.

No pretensions to finality are made, and no doubt many alterations and improvements in the instrument may suggest themselves. But this is offered as a modest approach to the problem of substituting gentle persuasion for excessive force in the correction of malposed teeth.

Department of Dentistry for Children

A CONSIDERATION OF CALCIUM METABOLISM*

ALVIN E. SIEGEL, M.D., MACON, GA.

CARIES of the deciduous teeth gives rise to derangements of the permanent teeth and consequent deformity of the maxillary bones. More immediate results of caries may be evidenced as local or as constitutional disorders. In caries of the teeth the probable sequence of events is decalcification of the enamel; tubular infection of dentin by microorganisms and formation of liquefaction foci; fusion of the latter and the production of cavities, and the ultimate dissolution of hard parts. Under the outer protective coat of enamel, which contains calcium, lies the dentin, which is a calcified connective tissue forming the body of the tooth and protecting the pulp or mass of vessels and nerves. The degree of calcification is a most important factor in the resistance to caries and in the preservation of the tooth. All the deciduous teeth and the germs of the maxillary and mandibular permanent first molars are partly calcified at birth. Consequently in an effort to obtain the optimum in dental calcification, it is necessary that attention be given in the prenatal period. Proper diet of the mother will result in a normal degree of calcification of the teeth at birth, but a properly balanced diet for the child is necessary to insure satisfactory completion of calcification of the deciduous teeth as well as that of the forming permanent teeth.

There can be no question that calcium metabolism, with the allied functions ramifying from or converging to it, is one of the most important physiologic factors of the body. The endocrine system is vitally involved in the function not only as a control factor in calcium handling, but in turn it is possible that the calcium concentration of the body operates somehow as yet not definitely known in maintaining the endocrine balance. It is known for one thing that calcium stimulates colloid storage in the thyroid. Among its other functions calcium plays a part in the coagulation of the blood, in the growth and development of the body skeleton, in the development and preservation of the teeth, and in other ways such as the healing process of tuberculous lesions.

The normal calcium metabolism represents the ingestion of calcium in the food or otherwise, its absorption, its storage and utilization, and its elimination. This sounds very simple, and it would seem that the fundamental requirement would be an ample supply of calcium-bearing substances. Low calcium intake is not the only cause for a decreased or low calcium balance.

*Read before the Sixth District Dental Society at Macon, Ga., October 8, 1935.
Reprinted from Journal of The Georgia Dental Association.

According to Cantarow[1] 1 gram of calcium per 100 grams of protein intake is the approximate daily requirement. The average American diet contains only 0.45 gram, because of its low milk and dairy product content. During infancy and childhood the calcium requirement is much higher because of the additional demand for growth and development especially of bones and teeth.

According to Brown and Tisdall[2] our chief sources of calcium are milk and the leafy vegetables, and it is absolutely impossible to furnish adequate amounts of calcium unless liberal amounts of milk are used. In passing it is interesting to note that this very important quality of milk is neglected in the advertising propaganda of milk producers, while they stress its food value and its vitamin content, both of which can be furnished by other products having much greater caloric or vitamin value per unit of measure.

Calcium is absorbed entirely by the small intestine, and its excretion is almost entirely from the large bowel. There is a great deal of difference between the absorbability and the assimilability of human milk and of cow's milk. Of the former 70 per cent is retained as compared with 30 per cent of the latter. The calcium content of cow's milk is 120 mg. per 100 c.c., while that of human milk is from 30 to 40 mg. per 100 c.c. In the past, studies have shown slow and sometimes doubtful absorption of certain salts of calcium. Improved results have been obtained by using other salts such as the chloride, the lactate, the bicarbonate, the glycerophosphate, and the gluconate. The absorption of calcium in the small intestine is not questioned. The important factor in calcium absorption is its solubility. The calcium salts, especially the phosphate and the carbonate, are freely soluble in acid solutions, while they are relatively insoluble in alkaline media. This fact must be borne in mind. Normally the calcium is in an acid solution in the stomach, but calcium absorption is not a function of the gastric mucosa. As the material is passed into the small intestine the acidity remains, but it is continually decreased by the outpouring of duodenal and pancreatic juices and bile, which are alkaline. It is during this period that the most of the calcium absorption must occur. In the alimentary content there are phosphate and carbonate ions and, as a result of digestion, fatty acids. As the acid reaction is neutralized by the duodenal secretions, the phosphate and carbonate ions tend to combine with the calcium and some of it is absorbed, but, as the hydrogen ion concentration increases with increasing alkalinity, calcium is precipitated largely as tricalcium phosphate and to a lesser degree as calcium carbonate. In addition the fatty acids combine with calcium and form insoluble soaps. Consequently the result of the normal digestive process is the absorption of a small proportion of the calcium, but largely the formation of insoluble calcium precipitates, which are poorly absorbed. According to McLendon and his associates[3] the intestinal content retains its acidity for a considerable period after passing through the pylorus. Under normal conditions this gives time for the absorption of adequate amounts of calcium.

Certain substances influence the absorption of calcium in addition to any influence of the hydrogen ion concentration of the intestinal contents. An excess of fat will inhibit the calcium absorption. An excess of phosphorus

has an unfavorable influence, as do also excesses of potassium and magnesium. An excess of chloride appears to aid calcium absorption. Lactose also increases calcium absorption. Vitamin D exerts an influence on calcium metabolism, but it is a mooted point whether or not it increases the absorption, although it does favor utilization. The same may be said of viosterol or irradiated ergosterol, which furnishes more vitamin D than animal fats or cod liver oil. There is no argument that this improves calcium utilization, and, while some of the extravagant claims originally made for this product have not been realized, there is no question of a definite value in the prevention and in the active treatment of rickets. Bergeim[4] presented results that seem to prove that the rachitic condition is due not to a failure to absorb calcium, but to its defective utilization, and this is due to low phosphorus concentration of the blood. Vitamin D overcomes this state of low phosphate balance by breaking down organic tissue phosphates. This increased phosphate concentration of the blood increases calcium deposition in the tissues with decreased excretion from the large intestine. The diminished calcium excretion favors phosphate absorption. The phosphorus and calcium balances are very closely linked.

According to Rothlin[5] the intermediary calcium metabolism is characterized by a blood calcium content of from 9 to 11 mg. per 100 c.c. Of this 2 mg. per cent are ionized, which is a most important factor with regard to the effect on the tissues. Another 3 mg. per cent are diffusible or not ionized, but are in complex compounds of labile equilibrium, easily passing into the ionized state and forming an available reserve. The remainder, approximately 5 mg. per cent, are nondiffusible, being combined with protein, and serve as a buffer for the stabilization of the calcium ion equilibrium. At least part of the diffusible calcium in the blood serum is in the form of free ionic calcium. There is reason to believe that this form is of primary physiologic importance. Two schools of thought, both supported by experimental evidence, have developed with regard to the state of this diffusible calcium. One has held that all, or nearly all, of the calcium not bound to protein is ionized. The other believes that of each 5 mg. of calcium not bound to protein, not more than 2 mg. can be in the ionized form. In order to account for the remaining 3 mg. a diffusible form of calcium bound to some citrate-like substance has been proposed. In view of the uncertainty as to the conditions present in the fluids of the normal body, it is not surprising that interpretation of abnormal observations has been the source of great difficulty. To the clinician this has meant that a normal figure for the total calcium of the serum might possibly conceal an abnormal distribution between the various forms, and that no sound basis has existed for clinical interpretation of abnormal fluctuations in the total calcium level. The key to these difficulties lies in the possibility of making direct observations of ionic calcium concentrations. McLean and Hastings[6] have reported a method designed to solve this problem. They used the isolated heart of a frog, which is known to be extremely sensitive to change in the calcium content of its nutritive fluid. They[7] had previously shown that this sensitivity could be reduced to quantita-

tive terms. The ionic calcium concentration in normal human fluids was found to be in the neighborhood of 5 mg. per 100 c.c. of fluid, and this held true whether cerebrospinal fluid, containing a total of 5 mg. per 100 c.c., or a serum containing twice this amount was examined. Thus it appears that all or nearly all the calcium in protein-free fluids is present in ionized form and that in protein-containing fluids, such as serum, plasma, pleural fluid, and ascitic fluid, ionic calcium and calcium bound to protein are together sufficient to account for all or nearly all the total calcium. There seems to be no further reason to propose quantitatively significant amounts of a third form of calcium in the fluids of the normal human body, although there can be no doubt that a small but insignificant amount of bound but diffusible calcium, corresponding to the small amount of citrate present in human fluids, does exist in these fluids. The calcium-protein relationship was investigated, and this study led to the discovery that ionization of calcium in protein-containing fluids is determined by a chemical equilibrium between calcium and protein. With the demonstration that the distribution of calcium between ionic calcium and calcium bound to protein depends on the total protein present, it becomes possible to calculate ionic calcium concentrations from values for total calcium and total protein. The first conclusion is that values for ionic calcium concentrations as calculated from total calcium and total protein are in substantial agreement with the values obtained from direct observation by the frog heart method. The usual and simple method for calculating ionic calcium concentrations from total calcium and total protein appears to be entirely adequate for ordinary clinical use.

The mechanism of calcium excretion may be somewhat confusing. Calcium is found in the urine as well as in the feces. That found in the urine represents calcium that has been absorbed and stored, or held in suspension in the blood. On the other hand, that found in the feces represents the insoluble or unabsorbed calcium of the intake plus absorbed calcium which has been stored in the different tissues or held in the blood until eliminated through the stimulation of various factors of metabolism. The intestinal elimination is from the large bowel.

The normal tendency of the body is to maintain its calcium equilibrium. If the calcium saturation of the various tissues is normal, an increase in the blood calcium as a result of calcium intake under conditions favoring absorption results in an increase of calcium excretion by the kidneys and the large bowel. If there exists a deficiency in the calcium of any tissue or tissues, such as bone, teeth, nerve, muscle or other structure, the blood calcium content is called upon to supply the deficiency regardless of the calcium concentration of the serum at the time. This gives rise to the low blood calcium readings encountered at times. Under such circumstances the elimination through the kidneys and the large intestine shows a reduction. Even in such a state of calcium depletion it would not be paradoxical to find a normal or high concentration of calcium in the feces, as this would indicate merely a high ratio

of unabsorbable calcium resulting from unfavorable conditions for absorption in the small intestine, and not the actual need for more calcium that the body requires.

The endocrine system plays a part in the mechanism of calcium metabolism. That the ovary should exert an influence does not seem illogical, as during a period of ovarian inactivity from the function of ovulation such as exists during pregnancy, the requirements of the mother for calcium are increased with the increasing demands of the developing fetus, and after gestation with the demands of her system for calcium to supply the needs of lactation. Bokelmann[8] studied this problem and found that the administration of ovarian hormone lowered the calcium content of the organism in his experimental animals. According to this, ovarian hormone is inimical to the maintenance of a high calcium balance, and as it is generally conceded that this material is freed into the circulation as a part of the process of ovulation, the cessation of this function during pregnancy should result in the removal of any inhibitory action of ovarian hormone on calcium metabolism, so that during pregnancy calcium metabolism should rise to higher levels.

Other endocrine glands undoubtedly are involved in calcium metabolism in a positive or in a negative way. In fact the interrelationship of the glands of internal secretion is so close that disturbance of the balance by dysfunction of one gland is followed by reaction of other endocrine glands. While several of the glands of internal secretion bear some relationship to calcium metabolism, the parathyroids are the key glands in this function. The influence of extirpation of the parathyroids to tetany and spasmophilia has been recognized for years. Later the presence of a low calcium concentration of the blood was observed. Isolation of the hormone of this gland by Collip[9] has made possible more definite experimental and clinical studies of the influence of its active principle. Ask-Upmark[10] stated that he had observed that the calcium content of the blood decreased after extirpation of the parathyroid glands, and that tetany could be stopped by the administration of large doses of calcium. Administration of the parathyroid hormone of Collip, which is known as parathormone, serves to raise the blood calcium level. This occurs in the absence of calcium administration as well as when calcium is given. It has been observed that, in the absence of plentiful calcium intake, administration of the hormone results in decalcification of bone and other tissues, in which it is present in an easily labile form. From this it is seen that the definite action of parathormone is to raise the serum calcium level regardless of whether the element is extracted from the current intake in the diet or from additional salts administered therapeutically, or stolen from the deposits in bone and other tissues. The danger of unguarded parathormone administration is readily seen. The presence of excessive parathyroid hormone in the system resulting either from the injection of the material or from hyperfunction of the glands results in the robbing of calcium from osseous and other deposits, and gives rise to pathologic developments. Considering the parathyroid gland aside from its normal function of meeting the requirements of the individual, dysfunction may lead to opposite ex-

tremes of the results of underactivity and of overactivity. The resulting calcium readings require evaluation. A low blood calcium concentration does not directly indicate that the bones, teeth, and other tissues are likewise low in their calcium content. Nor should a high calcium content be too reassuring. Other factors must be considered always. In the presence of a high serum calcium, roentgenologic study of the bones should be made as a check against calcium robbery resulting from excessive parathyroid hormone. The use of calcium or of parathormone is no index of the developments that may follow. While the use of the former may not result in improvement, it may be said to be comparatively safe, because even if calcium is absorbed in excess of any possible utilization the consequence would be at worst a high calcium content of the feces. Use of the latter, however, is more dangerous for if the blood calcium is low and its use is not buffered by ample dietetic and other supply of calcium, serious changes in the bone and teeth may develop.

Observation of the blood calcium concentration is very important, but it is seldom done as a routine. The technic of its estimation is not very difficult, but the collection of the blood from children presents problems which may seem insurmountable in everyday practice. In order to obtain the 2 c.c. of serum required, it is necessary to collect between 5 and 10 c.c. of whole blood. A micromethod was developed by Cantarow, but in a personal communication he stated that he had abandoned its use because of inaccuracies which sometimes occurred. In spite of the difficulties of securing the specimen, blood calcium determinations should be made whenever possible, and always when parathormone is used.

There is no question of calcium in the developing tooth being brought into and deposited in certain layers. Metabolism of calcium in formed teeth, however, gives rise to argument. In favor of the contention that there is an active metabolism in developed teeth, the following points are offered by Rothlin:[5] "(1) The calcium content decreases with a diet poor in calcium; (2) it increases with age, while the organic substance decreases; (3) decayed and old teeth contain larger amounts of magnesium than young and healthy teeth; (4) fractures of teeth heal by new formation of cement and not by callous formation; (5) foreign substances can be demonstrated in teeth such as yellow pigment in jaundice, tripan blue and scarlet red in intravital staining, lead, iron, and arsenic in dependence upon the time of determination, which can be explained only by an afferent and an efferent circulation; (6) formation of secondary dentin in dietetic treatment of dental caries and of dentin upon artificial irritation; (7) dull and discolored aspect of pulpless teeth. Well ossified normal teeth are covered with a smooth, glossy and perfectly white enamel. Sections of normal dentin show practically no interglobular spaces. A diseased tooth is covered with an uneven and pigmented enamel, and the dentin shows numerous interglobular spaces. Faulty structure and frequency of caries are parallel. The pathologic effect of disturbed calcification in the bones and in the teeth suggests the same cause for both. Many experiments have proved this."

Larsen, Jones, and Pritchard[11] studied dental decay as an indication of faulty diet. While their observations were largely on Hawaiian and Oriental children and on diets different from the average American diet, still their results are very interesting. They have been especially concerned with a condition of dental decay called odontoclasia, which affects deciduous teeth. They state: "That this condition or any type of dental decay is caused entirely or partially by diet has long been a matter of contention. Soft food has been regarded as a cause by some, and sugar, heredity, lack of calcium, or disturbance of the calcium-phosphorus ratio and deficiency in various vitamins, especially vitamins C and D, by others. Mothers have usually accepted the decay of deciduous teeth as nature's way of getting rid of the weak milk teeth. In a previous paper[12] attention was called to the excellent teeth of the ancient Hawaiians. The teeth of 22 Polynesian children still living largely on the old native foods were examined and found to be almost perfect. The teeth of another group of 55 Hawaiian children living in Honolulu and eating Oriental foods, mainly rice, were examined, and it was found that 98.2 per cent had decayed teeth. A recent report[13] from the Island of Triston de Cunha . . . apparently gives a striking confirmation of many of our observations. On this isolated island the teeth of 156 white islanders ranging in age from infancy to ninety-two years were examined, and 131 were found entirely free from decay. They never brush their teeth and their food is soft. Their diet is described as follows: 'They live on potatoes without salt and unaccompanied by tea or other food. They eat fish with nothing else, and penguin eggs and also milk.' . . . The observations on the Hawaiians, added to the observations on Oriental children, and the added confirmation of the Island of Triston de Cunha seem to answer several questions. 1. Heredity is not the important factor in dental decay. 2. Soft foods with great 'stickability' do not cause decay; i.e., Hawaiian poi is softer than Oriental rice. 3. Sufficient calcium alone does not correct the fault; i.e., infants on mother's milk and children on cow's milk show decay. 4. Vitamin D alone does not correct the condition; a great deal of sunshine, seven and a half hours a day, as well as addition of cod liver oil failed to prevent or arrest excessive decay. 5. Dental decay is due to a metabolic or dietary fault and not to an oral condition, since the beginning of decay could be shown before the eruption of teeth in children carried by rice-eating mothers. That aciduric bacteria grow more readily in an acid mouth medium enhanced by an acid residue diet and that such bacterial action increases the rapidity of decay is granted, but a metabolic imbalance makes the environment favorable and alone can produce soft, chalky enamel, and it may produce a process of decay without any bacterial action." Additional observations were made by the same authors on three groups of children. Group 1 were fed milk from rice-fed mothers supplemented with rice. Group 2 were fed on cow's milk and rice. Both of these groups received a small amount of vegetables and some eggs. In Group 3 the rice was replaced by poi and potatoes, alkaline starches, and a little more vegetables than in the other two groups was added. The most dramatic change was observed in the teeth, although there was also

a better standard of height and weight in Group 3. It was noted that 95 per cent of the infants on diet 1 showed some dental decay, and that 46 per cent of their teeth were involved. One hundred per cent of the infants on diet 2 showed decay, and 50 per cent of their teeth were involved. When these results were compared with the fact that only 7 per cent of the children in diet 3 and only 4 per cent of their teeth showed decay, the difference seems more than a mere coincidence. These observers thought that the replacement of a diet with carbohydrates giving an acid residue by alkaline starches was a factor although they did not express any opinion as to how this change to alkaline diet might improve calcification of the teeth and bones. It may be that an alkaline diet causes the outpouring of more acid from the gastric glands than an acid diet, thereby raising the acidity of the gastric contents to a higher degree. With a greater degree of acidity after passing into the duodenum a longer time is necessary before it is neutralized and then alkalinized by the fluids in the small intestines. In this way prolongation of the period of acidity in the small intestine may increase the absorption of calcium. Davis,[14] however, made observations on the effect of diet on the metabolism of calcium, phosphorus and nitrogen, which indicate that the resulting reaction of the diet plays little or no part except to a slight degree in the case of calcium. "In this investigation of the effects of acid-forming and base-forming diets on the calcium, phosphorus and nitrogen metabolism of children, the diets were proved to be acid and basic both by chemical analysis and by the effect on the urine. Only with calcium was an outstanding effect of the reaction of the diet obvious in the paths of excretion of the three elements. With the basic diet the excretion of calcium increased in the stool and at the same time increased in the urine, with the result that the total output of calcium was approximately constant with both acid and basic diets. With the acid diet the percentage of the excretion of phosphorus was only slightly decreased in the stool and correspondingly increased in the urine. The retention of calcium was uniform and apparently not influenced by the reaction of the diets. The retention of phosphorus tended to be increased with the acid diets, although the considerably larger intake during these periods may explain the apparently larger retention. . . . The reaction of the diets may be said to be without effect on the phosphorus balance."

As hinted above, the relationship between calcium and phosphorus in the body is very close. Other elements such as magnesium and nitrogen are bound in a more or less definite ratio with calcium and phosphorus. The scope of this presentation does not permit of more than a mention of these other elements, nor can justice be done to the importance of phosphorus metabolism. Reference has been made to the interdependence of calcium and phosphorus, and to emphasize this Davis (loc. cit.) is quoted: "The average daily retention of calcium (14 mg.), of phosphorus (from 8 to 14 mg.) and of nitrogen (from 32 to 146 mg.) compared favorably with those observed in other investigations. Sherman and Hawley,[15] who studied children of similar age, reported retentions of 9 mg. of calcium and 10 mg. of

phosphorus. Willard and Blunt[16] observed similar retentions of calcium and phosphorus in young children; in older children, however, although they found similar retentions of phosphorus, the average retention of calcium (27 mg.) was higher. In Burton's study[17] the values for the retention of calcium were determined to be between 1 and 5 mg. and the average retention of phosphorus was 11 mg. Boyd, Drain, and Stearns[18] found an average retention value of 17 mg. for calcium and of 14 mg. for phosphorus. For younger children, Porter-Levin[19] reported a calcium retention of 4 mg. and a phosphorus retention of 10 mg. Daniels, Hutton, Knott, Everson and Wright[20] determined the average retention of both calcium and phosphorus by their subjects to be 9 mg. They[21] also reported, for normal children between three and five years, retentions of calcium from 3 to 10 mg., of phosphorus from 6 to 8 mg., and of nitrogen from 34 to 90 mg."

Referring to the relationship of calcium and phosphorus and the rôles of each in rickets, which is one of the most common manifestations of abnormal metabolism, Bodansky and Jaffe[22] state: "Serum calcium is not a reliable criterion of the severity of rickets at admission, or of the rate of healing of rickets. Serum inorganic phosphorus is generally at a low level in severe untreated rickets, and rises on effective treatment. However, serum inorganic phosphorus responds to treatment so quickly that in cases of active rickets with a history of some previous treatment the relatively high serum inorganic phosphorus is not a reliable indication of the severity of the condition at the time of admission of the patient, nor is it a reliable indication of the stage or extent of healing during treatment. Serum phosphatase, the normal range of which in children may be stated as between 5 and 15 units per hundred cubic centimeters, rises in mild cases of rickets to about 20 or 30 units, in marked cases to about 60 units and in very marked cases above 60 units. These figures, which are supported by clinical and roentgenologic evidence, may be used as criteria of the severity of rickets at admission. The tendency to aggravation of rickets is strong. When antirachitic treatment is not given, serum phosphatase continues to rise; when therapy is not rapidly effective, serum phosphatase may rise slowly at first, then remain stationary or decline to normal values very slowly, over a period of several months. Even when therapy is rapidly effective, a lag of from four to twelve days may occur before a marked decline of serum phosphatase is observed. Its decline continues at a rapid rate until a high normal figure is reached within two months or less. Serum phosphatase may remain at this level for a considerable time while therapy is continued, indicating active repair. However, when complete bone reconstruction has taken place, the serum phosphatase is within the normal range. Serum phosphatase may thus indicate the effect not only of the antirachitic treatment but of the diet as a whole. Determination of the minimum rapidly effective dose of viosterol or other antirachitic agents by means of serum phosphatase analysis may be of advantage in the treatment of hospitalized patients. Persistence of signs of healed rickets sometimes lead to a diagnosis of active rickets. In those cases a normal serum phosphatase figure

may be used to correct the diagnosis. In our experience with this group of cases the evidence of serum phosphatase determination has been borne out by roentgenologic examinations."

According to Winters[23] the following conditions are associated with a decrease of the calcium of the blood; tetany, osteomalacia, pellagra, certain types of nephritis, colitis, fracture with nonunion, hyperthyroidism, acromegaly, Perthes' disease, malnutrition and sometimes the terminal conditions of such wasting diseases as malignancies and tuberculosis. He states that it is increased in gout, Paget's disease, pathologic fracture, tumors of the parathyroid glands, hyperparathyroidism, and hypothyroidism.

In the prevention and treatment of calcium deficiency diet should be the first consideration. Vegetables, especially the leafy vegetables, and milk are notably rich in calcium. Protein should be given in ample quantity. The diet should be acid producing rather than actually acid. Sunlight, vitamin D, lactose, and ammonium chloride also stimulate calcium absorption. Parathormone administration is recommended but with a close watch upon its effect and only if buffered by the free intake of calcium salts. Among these are the chloride, the lactate, the phosphate, the bicarbonate, the nitrate, the sulphate, and the glycerophosphate. A newer and apparently a much more satisfactory preparation is the gluconate. Calcium salts should be given in the interdigestive period, either four hours after meals or a half hour before meals. In the need of more definite or more rapid effects calcium may be injected subcutaneously or intramuscularly. Severe reactions may result but the gluconate gives much less local reaction when used by these methods than do other salts. The dose is up to 10 c.c. of a 10 per cent solution. In urgent cases the intraperitoneal or intravenous methods may be used especially with the chloride or the gluconate solutions. In small infants the injection may be made into the superior longitudinal sinus.

As a result of her long-continued investigations, Mrs. Mellanby[24] states that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation and in the diet of the offspring at the time of dental development substances containing an abundance of fat-soluble vitamins, calcium, and phosphorus, such as milk, egg yolk, fish, and animal fats. Vitamin D can also be obtained by exposing the skin to sunlight. Cereals, especially those rich in embryo, such as oatmeal, tend to produce badly developed or hypoplastic teeth and call for a correspondingly larger supply of calcifying foods for good development. The majority of children in the British Isles have teeth of imperfect structure and rough surface, which are much more likely to be attacked by dental caries than are perfect teeth with smooth surfaces. The resistance of teeth to caries can be increased independently of their original structure by giving a diet of high calcifying activity. Resistance can be decreased by a diet rich in cereals and of low calcifying properties. Her experimental work indicated that a deficiency of vitamin A or carotene plays an important part in the development of periodontal tissues and in the control of the onset of periodontal disease, including pyorrhea. She

claims that in order substantially to reduce the incidence of dental disease in the temperate zones drastic changes in the diet are necessary. The consumption of milk, eggs, cheese, animal and fish fats, and vegetables must be greatly increased, and the intake of cereals correspondingly decreased. She advises that no cereal be given the very young infant and urges that breast feeding be prolonged up to a year or more, provided that after six months of age a supplementary diet including iron, vitamin C, and the fat-soluble vitamins be given.

Calcium has been proved to be one of the most important elements in the human body. Practically every type of tissue contains some calcium; this accounts for the wide range of difference in the symptoms due to calcium variation. A certain amount of confusion and ignorance exists as to some of the aspects of the subject, but, with the increasing interest that is being manifested in the problem of calcium, it is to be hoped that in the near future the doubtful points will be cleared up.

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SOME PRACTICAL POINTS ON CHILDREN'S DENTISTRY*

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AS MY experience and observation of cases have been entirely confined to the Forsyth Dental Infirmary, I feel it necessary to give a brief outline of its history and methods of procedure. Through the efforts of Dr. Ervin A. Johnson, Mr. James Bennett Forsyth, a successful inventor and Boston business man, became interested in the dental welfare of the children of Boston and the surrounding communities. Mr. Forsyth decided to establish a place where children could receive dental care even though their parents could not afford to pay for it. He outlined a bequest in his will, but died before deciding upon the amount and before signing the will. His two brothers were appointed administrators of his estate. Being desirous of carrying out the unfinished plans of their brother, they not only set aside the amount they thought he had intended to give (about half a million), but they also added very largely from their own wealth, and founded the Forsyth Dental Infirmary. In 1910 the infirmary was incorporated, a board of trustees was formed, and a plan was outlined. A plot of ground was purchased, and a beautiful building was erected with a total cost of about three-quarters of a million dollars. From time to time the Forsyth brothers made contributions until the endowment reached nearly two million dollars. The work is now under the able direction of Dr. Percy R. Howe, assisted by his various committees.

The aim of the institution is to aid in all defects of the oral cavity, to teach the principles of oral hygiene, and to make every effort to determine wherein lies the prevention of dental defects. All children whose parents cannot afford a private dentist are eligible and are accepted for treatment. Not only has the infirmary benefited the children of Boston and vicinity, but it also acts as an educational center for young dentists who desire to become proficient in children's dentistry. A research department is maintained for the study of dental diseases, and the policies of practice are largely based on these findings.

I should like first to speak of child management. This is not so difficult as it seems, especially if you have a definite plan of going about it. It has been said that in a dental chair children like to be treated like grown-ups and grown-ups like children! In some cases this is true, but in handling children there are two prime factors to be remembered—kindness and firmness. Of course, kindness must come first. You must be kind to the child, yet sometimes use a reasonable amount of firmness. Success in handling children will continue only as long as you work these two factors together. Some children will, at the very start, begin to take advantage of your kindness. Of course, firmness will have to be resorted to at once.

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In my position I have come in contact with a great many of these so-called unmanageable cases; and, in many instances, they have not all been children who were afraid, but just stubborn and spoiled. As we handle between two hundred and two hundred and fifty children each day, I see quite a number of these difficult cases, and very few have to be sent away and refused treatment.

A nurse will come up and say, "I think it will take three or four to handle this child; he's a terror." This can usually be traced to home training, regardless of the child's being afraid or disobedient. If the child is afraid, this can be overcome in most cases by a few minutes of kind talk and explanation. If the child is of the stubborn type, firmness must be resorted to. This procedure is simple. Explain to the mother that a little force will have to be used; politely ask the parent to remain outside the operating room, as mothers are the biggest handicap in handling children. Place the child in the chair firmly but kindly, and place a folded dental napkin over the child's mouth. Surprising as it may seem, the procedure has a very marked effect. The child is not hurt, but made very uncomfortable for a few seconds. In all probability he will try to kick and fight for a short time, but, like breaking a colt, let him kick and you will soon have a nice quiet little patient. Remove the towel and pleasantly ask the child to take a drink of water. Then ask the child to open his mouth, and in most cases he will. This may, in some cases, have to be repeated, but the operator will win, and soon the child will decide that it is of no use to continue. Surprisingly, some of these make the best patients, and at other sittings you can do operations that may be unpleasant to them. You must be very careful at this first visit not to do any operations which will cause pain. If nothing else is done except to win the confidence of the child, this first visit is a success. It shows the child not only that you mean to be kind although firm, but that it is much better to endure a little pain without complaining as the work must be done.

This procedure is not original with me, but is used with much success and is advocated by Evangeline Jordan, McBride, S. D. Harris, and others.

Another great help in handling children is to allow them to ask questions. Do not be afraid of their wasting your time. Even the most time spent answering these children's questions does not amount to as much as you give your adult patients in letting them rave over some of their golf stories, etc. When all is summed up, the adult takes more working time away from the chair than does the child. Talk about the things which may be of interest to the child. It is easy to find out the things they like. Just let yourself drift into their frame of mind and they will make excellent friends. A very interesting thing for the young patients is to twist a few cotton pellets around the engine cord. Watch the expression on the child's face and see how it pleases him. Some will compare it to a dog, rabbit, or a race of some sort. It is the little efforts which please children and make it a pleasure to them to visit your office.

After gaining the child's confidence, do not abuse it by careless and painful operating. It is easy by careless tactics to lose all you have gained.

Treat the child with at least as much consideration as your older patients. Remember that the children of today are the adult patients of tomorrow.

Dentistry for children can be done with a small amount of pain. In going through a few points in cavity preparation it is wise to think of children's dentistry as being just a little different from work on adults. If this were not true, the colleges would not be adding to their course a separate department of pedodontia. The form of the deciduous molars, for example, is very irregular, and they do not run as true to form as do the permanent teeth. No definite class of cavity preparations has been outlined for them. In outlining his classification, I doubt whether Black ever had the teeth of the child in mind. Of course, you want to follow his classification as near as possible, but very seldom can it be done without injury to the pulp. One great thing to remember is to stay away from the pulp tissue, as it is much easier to stay away from it than to treat it.

The important thing to have in mind when preparing deciduous teeth is the removal of as much decay as possible, without involving the pulp tissue and getting the retention as best you can.

It is an excellent idea to work behind phenol compound, as it acts as an abatement. In applying a little to the cavity before or during drilling you will find that there is considerably less pain to the patient. Do not try to lift out all the decay at once, but take a small bur and go around the edge of the cavity. Then with a sharp excavator lift out the decay by small layers. It will sometimes take two sittings to prepare the cavity. If it does, remove as much decay as you can until the tooth becomes sensitive, then seal in beechwood creosote or eugenol. Let it stay until the next visit, and you will find that the cavity can be prepared with a minimum amount of pain.

Cavity preparation differs in accordance with the type of filling material used. When using silver amalgam you must have retention which is best gained by dove-tailing the occlusal surface.

Copper amalgam is considered the ideal filling for children and does not require as much extension. Its disadvantages are offset by its low coefficient of expansion and contraction, and its germicidal action. Its disadvantages are its color, slow setting, and tensile strength.

In sterilizing cavities, silver nitrate is one of the best agents that can be used. In some instances it is almost impossible to remove all the decay and get retention without injury to the pulp. If a small amount of Howe's ammoniacal silver nitrate is applied to the cavity and allowed to remain for two or three minutes, then reduced with the formalin solution, the cavity is rendered sterile and the filling can be inserted. In many cases, active caries has been retarded, and upon later examination a secondary dentin has been found to be laid down which is just as useful as the true dentin. I am not advising carelessly leaving decay, but is it not much better to try to save the tooth this way rather than get an exposure? This method of treatment will save many first permanent molars which are so valuable to the child and which otherwise might have to be extracted or have the root canals treated. When this silver nitrate solution is reduced by the formalin solution, you

have a true metallic silver which not only has stayed on the surface, but the silver has also penetrated the tubules of the tooth. This deposit is highly germicidal.

In observing quite a few teeth which have been affected by fever and are lacking in formation so as to prevent cavity preparation, I consider that it is well to preserve these by applying silver nitrate and reducing it until you get a mirrorlike effect of the silver deposit. This not only will preserve the surface, but will prevent much sensitiveness which is almost always present with such teeth. When the child is old enough, it is wise to prepare these teeth for crowns of some kind.

In capping pulps of deciduous teeth the chances are always against you. These cases have to be carefully selected. Very few will respond to treatment, and if examined in a few weeks will be found to be dead and putrescent.

For the treatment of pulps of infected permanent teeth for children we are using with much success Howe's silver reduction method. This procedure is simple and very effective. In using this treatment in anterior teeth, it is essential to coat the coronal portion heavily with cavity lining before introducing the solution into the canal. This is done to prevent discoloration.

In outlining this technic briefly, I take no credit, as it was brought out by Dr. Howe several years ago. The tooth is first x-rayed. The canal is opened and cleaned by means of a broach. In children, the canal being larger than in adults, one has little trouble in reaching the apex. If the tooth is abscessed, it is good policy to apply a small amount of silver nitrate and reduce it in the usual way, as this breaks up putrefaction. Allow it to drain. At the next sitting isolate the tooth and apply a small amount of the silver nitrate solution to the canal, forcing it to the apex with a canal drill, being careful not to slop it out into apical regions as it will cause pain just as any other root canal treatment would if applied carelessly. After waiting two or three minutes, apply a drop of the formalin solution and carry it into the canal as was done with the silver nitrate. In the reaction of this you have a metallic silver deposit which has penetrated the smallest openings in the canal. Of course, formalin is highly irritating, but after the reaction there is no formalin. If there is any doubt, you can place another drop of silver nitrate in the canal which will react with any formalin which may have been left after the first reaction. After two minutes apply a drop of eugenol, which will react any silver nitrate that might have been left, thus leaving metallic silver and maybe a trace of eugenol, neither of which is irritating.

The canal can be filled with any root canal filling you may desire, either plastic or otherwise. We use chloropercha. An x-ray picture is then taken to determine the correctness of the filling. Then a temporary filling is inserted and allowed to remain about three months. After that, if the tooth has responded satisfactorily to the treatment, a permanent restoration can be inserted.

I should like to report a case which came to us a few months ago. A boy, eight and a half years of age, had a maxillary left central incisor injured in an automobile accident. It was knocked from the socket and was supported

only by the soft tissues so the child could not close his mouth. The mother took the child to an oral surgeon who said that the chances were very poor, but that he would do what he could with the case. He placed bands on the teeth on either side of the injured one, and wired the tooth back in place. After about six weeks, the child was referred to us for treatment of the canal. We opened the tooth in the lingual surface, and with much care, as the root end was far from being calcified, we treated it by the method stated above. The tooth responded wonderfully, and later check-up pictures show that the tooth is in singularly good condition. If the tooth gives service for only five or six years, has not that been a great service to the boy, and well worth the time? The canal could not be filled completely, as we were afraid of forcing the chloropercha into the apical tissue and causing trouble. We know that in a root canal treatment there is some apical absorption, so we expect the tissue to fill in very nicely.

If a tooth has to be extracted before the time of its exfoliation, the space left should be maintained by space retainers. There are many types of these space retainers which are easily made, some consisting of bands for the teeth on either side and soldering a wire which will join each band, thus maintaining the desired space. This will prevent malocclusion in many cases. Dr. R. C. Willett of Peoria, Illinois, has done some wonderful work along this line.

Another great cause of malocclusion which is overlooked by many dentists is the abnormal maxillary labial frenum. This is an attachment from the fold of the mucous membrane to the membrane between the maxillary central incisors. It often goes between the incisors and attaches itself to the rugae of the palate. It is frequently overdeveloped, and can easily be noticed. When the lip is raised, the tissue becomes white, which indicates its attachment and abnormality.

This causes the central incisors to deflect from the median line, and the child's appearance is greatly affected by it, but it can be corrected easily. The operation is simple and causes very little discomfort. The area is anesthetized and the frenum dissected out, being clipped off at the fold of the lip. It is not necessary to use a suture as it will heal rapidly and cleanly. Some advocate a cautery, but in cauterizing there is danger of the tissue reuniting.

Forsyth maintains a nutrition department where the mothers and children are advised as to the character of the diet which tends to build sound teeth or to arrest caries. The records of this department disclose some interesting facts. For example, a study of the history of the children shows quite uniformly that those who have had the advantages of a good diet during their prenatal and infant life have broad arches and sound teeth, while the converse is true in the average case. When children who have come into our hands cooperate in the matter of dietary suggestion, it has been found that caries has been appreciably arrested so far as we can tell from a two-year record. Also, in a few cases in which no operative work has been done and the dietary suggestions have been strictly followed the carious teeth have healed as evidenced by the deposit of secondary dentin in the cavities.

The attempt to make a fundamental preventive effort by means of dietary correction is the direct outcome of the study on dental conditions which is carried on in the research laboratory. This research has been carried on since the infirmary was opened. The effect of vitamins A, C, and D deficiencies and of mineral deficiencies has been especially studied, and the results have been published. I would refer you to the general dental and medical literature for an account of the resultant pathology.

The diet of the mother during pregnancy plays an important part in the welfare of the child's dentition. At birth all the deciduous teeth are calcified, also the cusps of the first permanent molars and the tips of incisors; therefore, we realize that the important time to supply the tooth-building materials is during the prenatal period. The mother frequently stands between her baby and nutritional disaster. She builds the teeth of her child during pregnancy, and if she does not give the proper attention to her diet, nature tends to take from her blood supply, bones, and even the teeth themselves the needed minerals for the growing infant. She should choose her food wisely, and prepare it thoroughly, for it is not the amount of food taken that is important, but the amount assimilated. The pregnant mother should "eat for two," not in quantity but in quality, so as to supply the necessary minerals, vitamins, and other body-building foods to the child, for only through the mother can the fetus receive nutriment. Calcium should be supplied abundantly, and the best source of calcium is milk. Vegetables, especially uncooked and green leafy vegetables, should be emphasized, also fruits for their mineral content, vitamins, and laxative properties. The dentist should be able to recognize results of malnutrition, and should work hand in hand with the physician in seeing that the fault is corrected.

The deciduous teeth are just as important to the child as his permanent dentition. The child is growing physically, mentally, and structurally, and his teeth are needed to prepare properly the food necessary to carry on this growth. We do not claim that malnutrition is the sole cause of dental troubles, neither do we claim to know what the etiologic factor is, but we do know that nutrition and metabolism play a very important part in the process, and are worthy of attention.

In conclusion I cannot refrain from quoting Dr. Sweet in the November, 1931, *Dental Cosmos*, in which he says, "First, we as dentists must care for our patients, realizing that function is our aim to ideal dentistry. An extremely loose deciduous tooth, a cavity large or small, a pulp exposure, or an open pulpless tooth may prove such an aggravation to the child that he not only fails to eat the foods that need mastication, but refuses to eat almost everything and is known as a 'finicky eater' by the parents. Such children lose weight, are given tonics by their physicians, and prove a problem both at school and at play. They fail to show improvement until some one puts their mouths in such a condition that meal times are not approached with fear or pain."

DISCUSSION

Dr. A. L. Wooten.—We have long since come to accept the practices at Forsyth as final in children's dentistry, and we are extremely fortunate in hearing this presentation by one who has had long experience in an institution of such magnitude and rendering such invaluable service to both children and the profession. The subject that Dr. Rogers has discussed is constantly commanding more and more attention and respect from the profession and the general public. He has handled it in an interesting and commendable manner and with a conservativeness that proves his wide knowledge of the subject. We find here none of the sensational claims characteristic of the investigator who has not gone far enough to learn that things are not always what they seem.

The erroneous conception that child management constitutes a problem has complicated and hindered the cause of children's dentistry possibly more than any other one thing, and is certainly responsible for a large number of diseased and filthy mouths. I assure you that by following the general outlines given in this paper your child practice can, for the most part, be made not only delightful, but a profitable relief from the sometimes monotonous office routine.

Dr. Rogers considers the subject of child management as he finds it at Forsyth; I have to discuss it as I find it in the public schools of North Carolina; and you must consider it as you find it in your own private offices. Possibly the greatest difference under these different circumstances is the greater percentage of difficult cases in the private office. The private office gets more of the spoiled, high-strung children of the wealthier class. And while the child in the private office finds himself practically alone in a strange world, those at school or at Forsyth are in surroundings more natural and are simply called upon to do the things that other children about them are doing. But under any circumstances the prime factors mentioned in this paper are the keys to success. "Kindness, firmness, and KEEP THAT MOTHER AWAY!" This applies to any other attendant as well as the mother. Having the child alone is most important when dealing with difficult cases. May I add to these suggestions the necessity for truthfulness and naturalness of manner.

If the operator appears unnatural or too eager to make the child think that all will be well, the child is likely to grow suspicious and wonder what is hidden behind such a veil. Excited mothers or other attendants are especially good at arousing such suspicions. Such a situation is analogous to the mother partridge that flutters all over the place to attract attention away from her young. The average child has a fair degree of intelligence and is not going to respect you if you are not straightforward and businesslike in your dealings with him.

I do not regard conversation as of any great importance unless you happen to be born for that sort of thing. There are many like myself whose efforts at amusing conversation often fail, especially with the timid child. I consider it quite practical to follow the child's lead and to bear in mind that there are many who are delighted to be let alone in this respect.

While I agree with Dr. Rogers that it is wise after gaining the confidence or respect of the rebellious child to postpone any disagreeable work until a subsequent sitting, I am also mindful of the fact that it is sometimes inconvenient or impossible to do so. Circumstances under which I work have made it necessary for me sometimes to proceed immediately. And I am unable to see any considerable ill effect as a result of such procedure. If there is unpleasant work to be done, the child might not like it on a subsequent visit any more than he would on his first visit. If you really have gained the confidence of the child and proceed with the disagreeable work at once, he is likely to believe you when you tell him that the worst is over. In such a case the second visit will be uneventful.

As for the matter of confidence the thing that counts most is the thorough understanding on the part of the child that he is conferring no particular favor on any one but himself when he visits his dentist. If he has this attitude, your relationship with him will be pleasant. If he hasn't this attitude, he can still be made to respect you and be an obedient, though unappreciative, patient. To this type confidence and respect will come in time.

We have had so many diet fads that it seems risky even to venture an opinion on the subject. But I think we are at least generally agreed that a balanced diet would eliminate

much of our dental troubles. Just what a balanced diet is for each individual and how one is to obtain it are not yet determined, and probably will not be until the human system is completely standardized. When that impossibility is accomplished and all the fads of the extremist are worn to a frazzle, we can then calmly consider the expressions of Dr. Rogers and others of his type on the matter of proper feeding.

If the final word is ever spoken on diet, it will most likely be based on the simple natural foods that are available to the large masses of the people. There seems to be no good reason to doubt that a diet built around milk, fruits and fruit juices, and a variety of vegetables, and add to these what you will, would be sufficient for all human needs.

Dr. Rogers has touched on the use of silver nitrate. I do not believe that children's dentistry can be successfully practiced without its liberal use. In all posterior teeth where cavities cannot be extended to self-cleansing areas (and these are largely confined to deciduous teeth) silver nitrate is indicated, as well as in cases where some decay must be left. And in many cases of deciduous teeth where caries has advanced too far to permit any restoration it is most valuable in maintaining the teeth in a healthy state for an indefinite period, provided there is no pulp exposure at the time of application. Repeated applications may be necessary.

I am thoroughly convinced that every child's mouth should be freed of all infection and kept that way no matter how many teeth have to be lost in the process. There are far too many hopelessly diseased teeth left in the child's mouth for the avowed purpose of retaining the spaces. By all means, spaces should be retained, but if there is no way of doing it but to leave an abscessed tooth, or one with an exposed or putrescent pulp, then remove the tooth and let the space take care of itself. The possibility of future trouble should not be guarded against at the expense of present health.

As great as the need is for improved technic in children's dentistry, there is a still greater need for an impassioned desire to give our vast multitudes of children the conscientious service to which they are entitled, and for which they clamor if given the proper incentive.

REVIEW OF VIEWS ON VINCENT'S INFECTION

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AS A STUDENT in dental college my textbook on oral infections was *Diseases of the Mouth* by Sterling V. Mead of Georgetown University Dental School. In my practical treatment of Vincent's infection I have adhered closely to this authority. During the past few years, however, I have read many articles which disagree with what I was taught, many of them apparently directly contradicting these teachings; so much so that the present moment finds me in a confused state of mind regarding Vincent's infection as a clinical entity. I believe it might be interesting to review Mead's textbook and compare it with articles on this subject which have appeared in dental and medical journals. I have selected the following four articles, all from the *Journal of the American Dental Association:*

"Vincent's Infection" by Maurice Smith, D.D.S.

"Diagnosis of Diseases of the Gingivae" by Frederick W. Merrifield, M.D., D.D.S.

"Vincent's Infection" by S. Leonard Rosenthal, D.D.S.

"Camomile Therapy in Dentistry" by Herman Becks, M.D., D.D.S.

To simplify the study I have divided the investigation of the disease into its various phases as usually considered in textbooks and articles: history, nomenclature, location, symptoms, etiology, diagnosis, bacteriology, treatment, prognosis.

History.—Mead[1] credits the discovery of the disease to Dr. Thomas L. Gilmer in 1906. Smith[2] and Merrifield[3] agree with this. Rosenthal[4] and Becks[5] say that Plaut first described the angina in 1894 and that Vincent first described the causative organisms in 1896.

Nomenclature.—Mead suggests the term "ulceromembranous gingivitis" in the mouth and "Vincent's angina" in the throat. He gives as synonyms: acute ulcerative gingivitis and trench mouth. Merrifield practically agrees with this. Smith and Becks use the term Vincent's infection entirely. Rosenthal uses the same term but subdivides it into acute, subacute, and chronic types. He mentions as synonyms: Plaut-Vincent's infection, ulceromembranous stomatitis, and diphtheroid angina. Thus we see that this disease has been called by a variety of names.

Location.—Mead says that in its common form it is distributed throughout the mouth, surrounding most of the teeth. The usual location is the gingivobuccal border of any tooth, especially that of the first and third molars. It may also affect the throat.

Smith locates it on any mucous membrane, such as mouth, lungs, nostrils, and middle ear. It occurs only in mouths in which the teeth are still present. Merrifield says, "It rarely involves the entire gum margin, but rather arises

about a tooth here and there." Rosenthal says that besides the mouth, "Vincent's infection has been reported also affecting the fingers, conjunctiva, ears, nose, sinuses, vermiform appendix, genitalia, and central nervous system."

From these quotations we note that there is a great deal of difference of opinion regarding the location of the infection, varying from a few teeth to almost any part of the body.

Symptoms.—Mead lists the symptoms as follows: Appearance of a very sensitive, painful, and superficial ulcer of irregular shape, covered by a whitish gray membrane which is easily removed. Bleeding is usually profuse. The onset is sudden, accompanied by a typical bad odor, salivation, temperature of 100° to 102° F. occasionally, swollen glands, mental depression, and loss of appetite. The leucocyte count is usually below 10,000.

The other authors practically agree with this except that Rosenthal describes his subdivisions of the disease as acute primary infection, subacute, chronic; secondary, and tertiary.

Etiology.—Mead says: "Dr. Tunnicliff cultured anaerobically the Vincent's spirochete and fusiform bacilli, thus demonstrating them as the cause of this disease. They are most frequently found in ill-kept mouths, but they may be found in small numbers in healthy mouths. The virulency of the organisms depends on their environment. It is usually a disease of young people."

Smith gives as predisposing factors: systemic disease, excessive use of tobacco, decayed teeth, and badly fitting dental work, cryptic tonsils, extreme fatigue, and improper diet. The exciting factor is the presence of the spirilla and fusiform bacilli. Merrifield and Rosenthal practically agree with these views.

Becks is very skeptical about all this. He says: "We do not know whether the findings of Tunnicliff are to be accepted or not. We do not know whether Vincent's infection is really produced by these two organisms."

So here we find two widely different opinions.

Diagnosis.—Mead says that diagnosis is made first by the appearance of the typical symptoms as previously described, second by a microscopic examination of a bacteriologic smear taken from the lesions. A positive report is made from the presence of tremendous numbers of the specific organisms. Smith, Merrifield, and Rosenthal practically agree with this. Becks says that the symptoms or clinical picture will give a better idea of the disease than the bacteriologic findings. The smear test does not afford any information concerning the diagnosis.

Bacteriology.—Smith says that the fusiform bacilli are gram-negative, anaerobic organisms 10 to 14 microns in length and less than 1 micron in thickness. They are sometimes straight or a little curved, tapering at the ends. The spirochetes are long, irregularly waved, motile organisms or have a corkscrew shape. The fusiform bacilli predominate in milder forms of Vincent's infection; the spirilla, in more severe cases.

Rosenthal describes the fusiform bacilli as being 4 to 10 microns long and 1.5 to 3 microns thick. The spirochetes are 0.3 micron thick and 12 to 25 microns in length. They do not satisfy Koch's postulates for specific organisms.

Becks says that we do not know how many different types of spirochetes exist in the mouth. Five are well known. We do not know how many different types of fusiform bacilli exist there, probably more than four.

From this we see that even in the field of bacteriology, which is supposed to be a very accurate science, we find a great difference in views.

Treatment.—Mead says that all surgical procedure is to be deferred until the acute condition subsides. A thorough scaling is to be deferred until a later date. Local treatment by the dentist should be given two or three times daily, and the patient should continuously care for the mouth. Of the specifics, hydrogen peroxide is the most useful. The patient should be instructed to use a mouth wash of potassium permanganate frequently. He also recommends mercurochrome, methylene blue, acriviolet, and gentian blue. Cathartics should be used, and careful attention should be given to diet.

Smith offers no less than twelve different methods of treatment. He mentions pyridium, arsphenamine, copper sulphate, tincture of iodine, silver nitrate, sodium perborate, hydrogen peroxide, zinc iodide, chromic acid, zinc chloride, Fowler's solution, sodium bicarbonate, 5 per cent phenol, methylene blue, boric acid, and tincture benzoin. Kissing is banned. The patient must use his own eating and drinking utensils and his own towels. Treatment should be continued three weeks.

Rosenthal opposes the use of chromic acid. He recommends arsphenamine, bismuth sodium tartrate, and sodium perborate, but says that the use of sodium perborate alone is very slow and unsatisfactory.

Becks recommends three camomile preparations. He says that the teeth should be scaled as soon as possible.

Summarizing, we find no less than twenty-two different drugs or chemicals recommended in the treatment, and varied opinions. Evidently much simplification and standardization are needed.

Prognosis.—Mead says that favorable and prompt recovery is made where prompt and proper treatment is used. Frequent smears should be taken.

Smith, Merrifield, and Rosenthal agree with Mead. Merrifield issues the following warning: "In underfed, poorly developed, and uncared for children—those who are generally debilitated—the disease may pave the way for the development of noma, in which violent ulcerative and gangrenous destruction occurs."

Beck says: "I want to warn the profession strongly against the routine method of the smear test and advise them rather to take into consideration the clinical picture, which will give a better idea of the development of the disease."

Thus we see that in all phases of the consideration of Vincent's infection there is a lack of unanimity among dental authorities.

Let us now turn our attention to the medical field, first to an article which appeared in the *Journal of the American Medical Association,* "Fatal

Fusospirochetal Angina'' by Goldman and Kully.[6] These writers describe the organisms but say, ''For obvious reasons, fusospirochetal angina is a more descriptive term than Plaut-Vincent angina.'' They claim that the organisms are distinctly pathogenic and give the following records from the Cincinnati General Hospital: ''In a busy general hospital the ordinary case of stomatitis ulcerosa is treated in the out-patient dispensary. From 1929 through 1932 there were 21 patients with fusospirochetal angina admitted to the wards of the Cincinnati General Hospital. These patients were all admitted because of the severity of their symptoms. There were a total of seven fatal cases. All were adult negroes.'' They comment further: ''Fusospirochetal angina then can be a very serious disease, not only because of its direct ability in causing the death of the patient, but also because in its chronic form it can give rise to pulmonary abscesses, pulmonary gangrene, putrid otitis media, and gangrenous colitis. Schmitt observes that the areas of predilection are about the lower incisors, the last molars, and the tonsils. The prophylaxis then rests in the hands of the dentist, in the maintenance of oral hygiene; as well as in the hands of the laryngologist who should be on the lookout for tonsils chronically infected with these organisms. As evidenced by the cases reported here, the neglected cases come to extensive ulceration and then to death in spite of adequate therapy.''

Quite in contrast to this viewpoint is another article which also appeared in the *Journal of the American Medical Association*, ''The Pathogenicity of the Fusiform Bacillus and Spirillum of Plaut-Vincent'' by Lichtenberg, Werner and Lueck,[7] a report of a very thorough and scientific study of Vincent's infection, both experimental and clinical. It presents an entirely different picture of the status of this disease. The opening lines contain a challenge: ''It has been quite generally accepted that the Plaut-Vincent organisms have a pathogenic relationship to a variety of clinical entities. Unexceptional proof of such a relationship is wanting.'' The authors then describe Vincent's work on this subject, and their comment is: ''He was unable to cultivate the organisms and to satisfactorily attest their pathogenicity.'' The authors then describe their own laboratory experiments with guinea pigs, in which they attempted to duplicate the work of Tunnicliff and other early workers in the same field who claim to have produced the disease experimentally. They had no success and reported, ''These experiments and others with minor modifications were always negative.''

Referring to the many conditions with which the organisms have been found associated, they say: ''It seems improbable that these organisms play the determining rôle in the causation of all these conditions. It would seem at least as probable that they are saprophytes growing on lesions caused by other agents; and only rarely, if ever, becoming pathogenic. If it is assumed for the moment that the Plaut-Vincent organisms are saprophytes, one might expect to find their numbers very much increased when dead tissue as the result of a clean surgical wound is present for them to grow on. The membrane covering the tonsillar beds following the removal of the tonsils furnishes good and abundant material for investigation. Children up to the age of thirteen years admitted to the Children's Memorial Hospital for ton-

sillectomy were studied. For several weeks previously and at the time of operation they were well and had no fever, nor infection of the upper respiratory tract or pharynx. Immediately following the operation, smears were made from the surface and crypts of the extirpated tonsils and were examined for Vincent's organisms. Of 108 patients, they found that 46 per cent showed fusospirochetal organisms in the smears from the tonsils themselves. In six they were present in sufficient numbers so that the smears could easily be taken for those coming from cases of Vincent's angina." Yet remember that these children had no symptoms of any sort of angina and no fever. "The children were seen again on the fourth or fifth postoperative day. Smears were now made from the membrane covering the tonsillar fossae following the removal of the tonsils themselves. Among the children in whose tonsils the organisms *had* been found, 98 per cent showed them in the membranes following the operation. An *increased* percentage—17—were so numerous that a diagnosis of Vincent's angina might seem justified from the smears."

But now comes a very interesting observation: "Among those children in whose tonsils *no* fusospirochetal organisms had been found, they *were* present in 91 per cent of the membranes *after* the operation. All but one of the 108 children were seen two or more times postoperatively. For the most part the cases ran the usual uneventful course of recovery."

The authors then criticize the array of drugs and treatments usually offered; especially are they against the use of arsphenamine. "In view of the evidence for the efficacy of arsenicals in the treatment of lesions attributed to these organisms, it becomes difficult to explain the presence of these organisms about the gums of patients undergoing active antisyphilitic treatment. It is even more awkward to explain the development of an acute Vincent's angina in these patients. Sutton in this connection justly raises the question that if sulpharsphenamine is of value in the treatment of Vincent's, should not a comparatively high body saturation protect the individual against the disease?"

"Since one learns from the literature that the lesions of ulcerative stomatitis attributed to these organisms heal in a short time with any one of many treatments, it seemed of interest to follow the natural course of this disease." That is, where no specific treatment was to be given. "Patients with ulcerative stomatitis who came to the out-patient ward of the Children's Memorial Hospital were referred to us from the general clinic. The mild and doubtful cases were referred back. Only the sixteen more severe ones with many ulcerations in the mouth and reddened, swollen gums were followed. The patients varied in age from thirteen months to twelve years. They all had concurrent throat infections. Smears from the lesions usually showed a great many fusiform bacilli and spirochetes." No specific treatment of any kind for Vincent's angina was given. "We gave small doses of aspirin which may have made the children feel more comfortable but hardly can have had any direct effect on the local condition. The children were all well in from four to seven days." They conclude: "The value of diagnostic

smears for Vincent's organisms is questioned. Whether many, few, or no organisms singly or combined are found, the interpretation and the course of the case remain unchanged. We feel justified in questioning a fuso-spirochetal pathogenicity, and that is our sole purpose in this report.''

SUMMARY

Among both dental and medical authorities, the status of Vincent's infection is still doubtful. It behooves all of us to keep an open mind on this subject until it has been investigated further.

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Department of Orthodontic Abstracts and Reviews

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A Course of Study in Dentistry. By Curriculum Survey Committee: Drs. Wallace Seccombe, John T. O'Rourke, Arthur D. Black, H. Edmund Friesell, Harry M. Semans, Chicago, 1935, American Association of Dental Schools.

The report has as its object to outline a course of study most suitable for the general practitioner of dentistry. "It summarizes the oral health conditions of the people, analyzes the responsibilities of dentistry, states the objectives of undergraduate dental education, and sets forth the knowledge, skill, and experience which the student should acquire."

It is not so much concerned with critically reviewing methods of teaching employed at the present time as to arrive, with the use of scientific methods, at the requirements of a dental curriculum which will be adequate for the human needs of the people.

A change in the dental curriculum is necessary due to expansion of the field of dental services. Dentistry in the past consisted principally of restorative services, and the curriculum was devised accordingly. Research has since shown that many general body ailments are due to disorders of the teeth, and dentistry is now regarded as an important part of health service. Dental education must, therefore, be adjusted to the new requirements.

The groundwork for this study was laid by an investigation of dental education of the Carnegie Foundation, carried out by William J. Gies. His report brought about a better understanding of (1) the function of dentistry as a health service; (2) the organization of dental education; (3) the need for curriculum revision; (4) the necessity for dental research.

The present survey consists of three steps: first, to obtain a comprehensive view of the requirements for oral health service; second, to determine the subject matter to be included in the dental curriculum; third, to arrange the courses in the various subjects and to outline the requirements for admission to dental schools.

Before the various dental subjects are discussed separately and in greater detail, attention is called to a subject not generally found in the dental curriculum. It is named "Orientation in Dentistry," and its importance, as well as its scope, is best illustrated by the suggested outline of instruction, which, at the same time, gives an example of how the outlines in instruction are prepared throughout this survey.

OUTLINE OF INSTRUCTION IN ORIENTATION IN DENTISTRY

1. The objectives of dentistry (1 hour).

(a) Health service. (b) Esthetic appearance. (c) Restoration of function: Mastication. Speech.

2. Conditions dealt with in dentistry (Combine with No. 1).

(a) Conditions of the hard tissues of the teeth. (b) Conditions of the dental pulp. (c) Conditions of the investing tissues of the teeth. (d) Conditions of the other soft tissues of the mouth. (e) Conditions of the mandible and maxillae. (f) Systemic sequelae of mouth conditions. (g) Oral manifestations of systemic diseases. (h) Dental anomalies and deformities.

3. The types of dental service (Combine with No. 1).

(a) Hygiene and prophylaxis. (b) Diagnosis of dental conditions. (c) Orthodontics. (d) Operative dentistry. (e) Dental prosthesis. (f) Surgery. (g) Oral medicine. (h) Recognition service: Tumors. Systemic conditions having manifestations in the mouth. (i) Consultation with physicians, surgeons, dental specialists, and other dentists.

4. The phases of dental education and the reasons for their study (1).

(a) The sciences. (b) Diagnosis. (c) Treatment. (d) Prevention. (e) Professional, social, and economic relations.

5. Contacts of dentistry with other professions (Combine with No. 4).

(a) With medicine. (b) With nursing. (c) With public health work. (d) With technicians (radiographers, laboratory technicians, etc.). (e) With specialists in dentistry.

6. Scientific and critical point of view in dentistry (2).

(a) Meaning of a scientific and critical point of view; contrast with dogmatic, empirical, and rational points of view. (b) Need for a critical point of view in the study of dentistry. (c) The basis of scientific knowledge. (d) The steps of scientific procedure. (e) The extent to which the scientific point of view can be applied to dentistry under existing circumstances. (f) The extent to which the dogmatic, empirical, and the rational points of view are useful in dentistry under existing circumstances. (g) The attainment of the scientific and critical point of view. (h) The dental student's application of the scientific and critical point of view in his study.

7. How to study in dentistry (2).

(a) Problems peculiar to the study of dentistry. (b) Importance and value of independent study. (c) Study routine. (d) Taking notes from reading. (e) Taking notes from lectures and class discussions. (f) Use of reference books and material. (g) The mastery of the art of study. (h) Preparation for an examination.

8. The educational environment of the student (Combine with No. 7).

(a) The city and its educational opportunities. (b) Professional educational institutions in the city. (c) The dental school in which the student is enrolled: History. Ideals. Educational status. Opportunities.

9. Dentistry as a profession (1)

(a) Meaning and characteristics of a profession: Service to humanity. Well-established procedures of practice. Extensive educational requirement. Individual responsibility. (b) The social status of a profession. (c) Dentistry a profession; its responsibilities.

10. The dentist as a professional man (1).

(a) Personal and social qualities and traits. (b) Intellectual and cultural attainments. (c) Professional qualities and attainments. (d) The opportunity of the dentist for leadership in the community. (e) The relation of the dentist to fellow dentists and other professional men. (f) Development of professional attitudes and habits in the dental school.

11. The development of dentistry (1).

(a) Outstanding leaders in the development of dentistry. (b) Development of various fields of dentistry.

12. The agencies of communication in dentistry (1).

(a) The importance of communication in the advancement of a profession. (b) Dental societies. (c) Dental schools. (d) Dental periodicals.

Total time: Class, 10 hours.

The basic sciences to be included in the curriculum are: physics, organic chemistry, physiologic chemistry, anatomy, histology and embryology, oral anatomy and oral physiology, materials used in dentistry and their manipulation, physiology, nutrition, bacteriology, pharmacology, and pathology.

The clinical subjects comprise: mouth hygiene and oral prophylaxis, application of preventive principles in dentistry, radiography, diagnosis and treatment planning, orthodontics, operative dentistry, oral medicine, anesthesia, oral surgery, dental prosthesis, and principles of medicine.

Other courses suggested are: technical composition, history of dentistry, social and economic relations of dentistry, practice management, clinical dentistry. Further chapters deal with preliminary college education and recommendations.

Education in orthodontics for the general practitioner of dentistry should consist of a training enabling the student to recognize malocclusions, to use preventive measures, and to treat less complicated cases. Other objectives of the orthodontic course are: (1) to aid students to understand related points in other fields of dentistry, (2) to prepare them to advise patients regarding malocclusion, (3) to teach students to understand the dangers of orthodontic treatment, (4) to prepare them to arrest cases of malocclusion

There is a greater difference of opinion regarding the study of orthodontics than probably any other subject in the curriculum. Twenty-nine out of sixty-three dental schools favor sufficient orthodontic training to enable the undergraduate to treat simple cases. Ten of the schools favor teaching them to treat all but the most difficult cases.

Clinical work in orthodontia is required in only twenty-five of forty-three schools, while it is optional in the others. In seventeen schools the instructors adjust the appliances, in twenty-one schools the students do, in six the instructors assist the students. The appliances are made by students in twenty-three schools, by instructors or technicians in eighteen, while in four they are bought ready-made.

The report recommends, "in view of the important place which orthodontics should have in the general practice of dentistry," that every dental student should perform clinical treatment on a number of cases of malocclusion. He should also construct the appliances and make the casts.

A questionnaire sent to dentists reveals the viewpoint of the profession in this matter. The largest number of them advocate that the dental student be made familiar with the theories of correction and methods of diagnosis, but that clinical work should be delegated to orthodontic postgraduate courses. Others believe in a sufficient clinical training for the undergraduate student to enable him to treat "simple" cases of malocclusion (while others

question whether "simple" cases can always be distinguished from complicated ones). A third and smallest group advocate intensive laboratory and clinical training, so that the dentist after his graduation will be able to do orthodontia as well as operative dentistry.

Complete specialists in dental fields were found to be distributed as follows: (a) oral surgery, 40.5 per cent; (b) orthodontics, 28.5 per cent; (c) prosthodontia, 9.5 per cent; (d) periodontia, 8.9 per cent; (e) pedodontia, 6.2 per cent; (f) operative dentistry, 1.9 per cent; (g) radiography, 0.6 per cent; (h) two or more fields combined, 3.8 per cent. The complete specialists comprise about 3 per cent of all dental practitioners.

The Arizona law requires a special license for the orthodontist, which he obtains by following the usual dental curriculum with certain changes; these consist in the substitution of a larger amount of orthodontics for subjects like operative, prosthetic dentistry, etc. The dentist without such training and license is not permitted to treat orthodontic cases.

For every one connected with dental education, this report will prove to be a source of most interesting data. The orthodontist especially will be surprised to find that—for some reason—his branch has not found its proper place in the dental curriculum. While it probably requires not any less skill to construct a prosthetic restoration than it does to treat a case of malocclusion, the dentist during his studies is trained to do the one, but not the other.

The reason for this procedure is, in all probability, the shortness of time in which orthodontia has developed. But even in this short time, it has developed fast and grown rapidly. That it soon will demand and must receive its rightful place in the curriculum, becomes evident to the person who has occasion to examine a large number of children's mouths. Never will a limited group of specialists be able to take care of all these malocclusions.

Furthermore, as preventive dentistry will be practiced more extensively, the need for oral surgery and prosthetic work will gradually decrease, which should permit a rearrangement of the dental curriculum with greater emphasis on orthodontics. Such a development will advance the standards of dental health to a level which now can be attained only in exceptional instances and will take care of the ever increasing demand of the public for orthodontic services. Then the dental student will, as in other dental subjects, receive adequate theoretical schooling and laboratory training in the first years of the dental course, while a sufficient number of hours in the latter years will be devoted to extensive clinical work on orthodontic cases. After he graduates and receives his diploma, he will be able to administer aid to the poor deformed mouths of children as well as still the pain of toothache. Truly, he will not be expected—without further postgraduate work—to obtain as beautiful results as the specialized orthodontist, but neither will his bridgework stand comparison with that of the prosthetic specialist.

E. N.

The Forum

Articles for this department should be sent to Dr. Albert H. Ketcham and Dr. William R. Humphrey, 1232 Republic Bldg., Denver, Colo.

The Problem of Extraction in Orthodontia

Dr. Arthur A. Libby's letter published in the August, 1935, issue of the INTERNATIONAL JOURNAL OF ORTHODONTIA advocating the symmetrical extraction of the first permanent molars before the eruption of the second permanent molars as a preventive measure in certain cases of malocclusion raises many points of serious concern to orthodontia. Although enough evidence has been produced to show the ill effects from the loss of a tooth or two upon the alignment of the teeth in the dental arch and their resultant position in the alveolar process, I shall attempt to present another angle of the question in the hope that it may help clarify the confusion which exists.

The practice of extraction in the treatment of malocclusion has been followed to a greater or lesser degree during various stages of the development of the science of orthodontia. A great deal of Angle's pioneering days were devoted to a combat with the extractionists at that time, and his classification of occlusion was developed, to a great extent, for the purpose of proving the fallacy of the procedure. Today there is a similar trend in that direction, and Simon's orbital law of the canine which has been disproved by the studies of Connolly,[1] Broadbent,[2] Wolfson,[3] Oppenheim,[4] Hellman,[5] and Krogman[6] was basically a scientific attempt to defend the practice of extraction.

Clinical evidence, furthermore, demonstrates the possibility of satisfactory treatment of those cases of malocclusion for which extraction was and still is advocated. The work of Hellman on the growth of the face and its relation to the dentition[7, 8, 9] shows us the importance of any tooth in the dental arch. A short cut in treatment by resorting to extraction may be the privilege of any practitioner in his private practice if he is satisfied with inferior workmanship, but to present this practice as a scientific principle is not justified. To perform such an operation during early childhood as a preventive measure is an interference with natural growth.

Dr. Libby in advocating this procedure is carrying the practice of prevention to a dangerous extreme. Studies of the development of the dentition from infancy to adulthood have shown that we cannot predict the outcome of the adult dentition from the condition of the deciduous teeth or that of the mixed dentition.[10, 11, 12, 13] There may be definite indications of malocclusions, but natural changes brought about by growth and development make the adult dentition often very different from what might be expected. To resort to extraction,

whether it be symmetrical or otherwise, is a radical procedure, which, if it has any purpose at all, only obscures our understanding of a condition we have no means of knowing will actually occur.

The only justified reasons for extractions are (1) definite impactions, determined after nature has been given a chance to complete its part in the growth and development of the child; and (2) any pathologic condition which cannot be eradicated in any other way. A dentist may be justified in the removal of an unsightly malposed tooth from a matured individual where orthodontia for some reason or other is not possible or advisable, but to extract and then resort to orthodontia is a procedure in orthodontic service which is condemnable in the light of present-day knowledge.

In defending his principle, Dr. Libby has brought up the question of economics in orthodontia. It is a recognized fact that proper orthodontic services to the masses are not available, but this is a problem which must be solved in another way, and resorting to extraction of teeth on children in the hope that it may prevent malocclusion is much worse than no orthodontia at all.

The ideal normal occlusion is a goal which, though impossible to attain, is considered, on general principles, the best functional occlusion and most conducive to a healthy dentition. Although normal occlusion is found to vary considerably and congenitally missing teeth often are complications to be overcome, a full complement of teeth regardless of the malocclusion present is more favorable for orthodontic treatment than a dentition which is marred by extraction or by the congenital absence of one of its members. The orthodontic problem is a complicated one; extraction whether it be for prevention or for treatment aggravates that problem. The solution must be sought elsewhere. Short cuts of this nature hinder progress.

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M. A. Munblatt.

A Critical Review of "Befogging the Issue to the Dental Profession"

This paper by Edward Mason Griffin which appeared in September issue of this JOURNAL contributes to a controversy which has provoked discussion in educational and professional societies and publications for several years. There is no thought that an analytical review will terminate exposition of the variant viewpoints or that it would be beneficial so to do, but rather with the hope that it may contribute to a clearer understanding of a problem the ultimate solution of which affects the character of a specialized dental service and a standard of performance rendered by the dental profession.

The problem deals with agencies for providing specialized instruction in orthodontics. As might be expected, contributions of the discussion have arisen, on the one hand, from persons holding appointments in departments of dental schools and, on the other hand, from those interested in proprietary courses. For this reason their nature resembles a debate more than an analysis. The profession must subject the material to careful scrutiny not only from the standpoint of the text but also in the light of the interests and background of the contributors as well. In this instance Dr. Griffin is an exponent of the proprietary school and of the practice of orthodontia by the general practitioner of dentistry. This present review is written by one with previous expressions advocating training and experience by those practicing orthodontia, be they general practitioners or specialists, also for those limiting their practice to orthodontia or claiming to be specialists the added requirement of special training and experience. It is my opinion that the university if properly utilized has the possibilities for most satisfactorily supplying this specialized training.*

In the second paragraph of Dr. Griffin's paper he says that the proprietary school "should be reported relative to ascertaining a reliable evaluation of its activity," and at this point as later in his article he justly raises a point which has been grossly misrepresented heretofore. We have not been favored with any reliable evidence of the advantages of either college or proprietary results of teaching. Yet there has arisen a sort of glamour about the courses given under the roof of a university. There is, of course, no virtue per se in college or university instruction. As Dr. Griffin suggests, the two should be judged in like terms by the end product of their efforts. A careful study of the clinical ability of a large number of students of both avenues of thought might be enlightening. Unfortunately our attention is directed from time to time to isolated individuals of exceptional ability. In the absence of a more practical and scientific appraisement we are forced to base opinion upon the proportion of which of the facilities of these various schools meet requirements which in the light of our several experiences supply the need of one who wishes to practice or specialize in orthodontia. Our experiences are diversified, our standards of performance vary, our concepts of public responsibility are multiform, our desire for economic security is human and apparent. The result is chaotic. There is great question whether

*Existing Trends in Specialty Education and Legislation With Particular Reference to Orthodontics, Angle Orthodontist, April, 1934.

we shall reach any satisfactory agreement in the content and method of orthodontic teaching until there is greater unanimity of thought with respect to these questions.

The argument advanced by Dr. Griffin that our outstanding figures in the specialty have been trained by proprietary agencies is quite true but of no logical application to the question at issue. Proprietary training, being practically the only source then available, they took it. At the time my grandfather sought dental training, practically all dental colleges were proprietary; yet many splendid practitioners were produced either because or in spite of the institutions. When I came to the decision of training for the same profession, he was the last to suggest that I ignore the educational progress of two generations. We cannot deny the individual in the equation from the standpoint of ability to profit by experience and benefit by the opportunities at hand, however meager. The vital question is, on what program will the greatest opportunity be supplied the most adept students and minimize the failures? We return again to a desire to compare the clinical results of the average product of the teaching methods now in vogue.

Mention is made of the necessity which forced such men as Angle to leave the university to pursue their teaching adequately. This returns us to a strong point in Dr. Griffin's argument, namely, not university or proprietary school but their purpose and curriculums. From these two standpoints no classification can be made which will show any correlation with respect to either time or content of the courses offered. The personality of the teacher is still of greatest moment. It should be recognized that the teacher is more important than the equipment of his laboratory. One cannot teach any science with understanding, but there are a few teachers who are favored with the faculty of inspiring learning. Given the facilities of the cooperative departments of a university and the personality of a great teacher, and we have a combination which will exceed the results of personality without the facilities, and, if we deprive the student of both, the average product will be miserable no matter who sponsors the instruction.

Further in the paper, quotation is made from the report of the Dental Educational Council of America, " 'The dental graduate should be prepared to begin with adequate safety the practice of dentistry, but experience is essential for his proper development.' " It may still be said that dental schools as a class do not teach sufficient orthodontics to enable the graduate to "begin with adequate safety the practice of dentistry," while orthodontics is included. The state board examinations do not adequately safeguard the public. As the foundation for these statements is supplied elsewhere, further discussion is omitted.*

Another old argument is raised by Dr. Griffin when he mentions the "twenty thousand" who now choose to practice orthodontia to a varying extent. He feels that they should have the facilities of instruction to prevent harm which might be done. One cannot help but wonder whether this crust of learning which is thrown to the starved mind of the orthodontic aspirant will not prolong his suffering and that of the public. It is not inconceivable that many might be encouraged to start such a practice by this procedure and in this way augment

*A Consideration of a New Step in Orthodontic Legislation, J. A. D. A. February, 1931.

the dilemma which Dr. Griffin decries. Again it is the question neither of university or proprietary course nor of general practitioner or specialist, it is in reality a matter of fundamental training in the place of smattering for any one who wishes to effect the welfare of a patient possessing no criterion upon which to form judgment.

The following quotation is of interest: "To attempt to limit the practice of orthodontia to those who have received what may be deemed adequate training as befitting a specialist by certain proponents of the university system is analogous to the proposal to raise the dental educational requirements so that the dental degree can be attained only after the medical degree." As far as I know there are no orthodontists of any group who at the present time advocate limiting the practice of orthodontia to those receiving any particular amount or character of *special* instruction. There are those who would prevent practitioners without special fundamental and clinical training from presenting themselves to the public as specialists. And there are others, the writer included, who feel that the present dental course does not offer sufficient didactic and clinical instruction even if augmented by a few weeks of intensive instruction by able and well-meaning teachers.

This quotation above together with the following "This would create the superdentist, and all ordinarily trained professional brethren would be his 'technical assistants,'" refers, perhaps, to the attitude of the late Dr. Alfred Owrie, who recognized that the mechanical emphasis of dental training centered attention upon the technical proficiency of repairing the ravages of dental disease rather than upon the treatment and prevention of the disease, but who, if we are able to judge by his own writings rather than those maliciously purported to him by contemporaries of narrower vision, never suggested that his "brethren" be relegated to "technical assistants."* It might be added, although it has no more relation to the question at issue than the quotation which prompts it, that the dentist, or orthodontist for that matter, who practices from a mechanical viewpoint alone is the agent who will eventually remove the profession to the status of technicians.

The establishment of understanding, cooperation and harmony between the department of orthodontia and that of general dentistry is most earnestly to be desired. There is, however, something of a question whether our existing societies, particularly those of city, state, and national character, do not possess the mechanism for accomplishing this end. There is more than a suggestion that a major purpose of the dental societies suggested by Dr. Griffin would involve education for the practice of orthodontia. "Dental societies should be organized for the specific purpose of disseminating knowledge which will inculcate a sense of responsibility wherein the practitioner will not attempt the treatment of complex cases through advice from a commercial laboratory. . . . A natural educational development for the treatment of the complex cases should evolve from

*The following quotation from Dr. Owrie suggests that it should be possible to train men to work under the directions of the specialist but in no way intimates the subrogation of existing general practitioners of specialists. "It is possible to train men for the mechanical work in a much shorter time than is required for the oral specialist and in much greater numbers. The latter should work only under direction of the former." Discussion of Dr. Owrie of "Dental Education" by Frank M. Casto read before a meeting of the New York Academy of Dentistry in New York City, February 26, 1931.

experience in treatment of the simpler conditions and from work in the preventive field.'' It will be remembered at a recent meeting of the section on orthodontia at the time of adoption of the curriculum for that subject in the Curriculum Survey Committee of the American Association of Dental Schools, no one either of the committee or present at the meeting was willing to define or differentiate the simple from the complex cases. It could scarcely be assumed, however, that Dr. Griffin even in his enthusiasm would suggest the formation of dental societies for the purpose of acting as the agent to supply the training from the point where the dental school graduates its students to the treatment of complex cases of orthodontia, whatever they are.

But he feels that whether the instruction comes from the dental society study club, the proprietary school, or wheresoever, it should not matter. ''The source of the instruction should not be considered since it is the welfare of the public that is to be considered.'' This might better have been written. ''The source of the instruction *should* be considered since it is the welfare of the public that is to be considered.'' Medicine and dentistry have, we hope, passed beyond the place where the public must pay the major part of the bill for experience of the practitioner.

There follows in the final pages a characterization of the essential requirements of the course which Dr. Griffin feels desirable for postgraduate work, be it university or otherwise. The content of the outline is too vague to justify discussion in detail. With respect to principle, Dr. Griffin has suggested that the basic sciences be obtained by the student through his own review, feeling that ''much time has already been spent in learning those subjects.'' The didactic work lies principally in an extensive series of correlating courses in which the pertinent and vital facts and relationships are supplied in a form condensed and easily assimilated. Technical and appliance courses and bench work are mentioned. Clinical experience, he feels, covers too long a period to warrant inclusion even in the university course of two years at one-half time.

The experiences of men differ. It has been my experience that a knowledge of the fundamental or basic sciences is essential to understanding and that correlation possesses meaning only when the teacher can rely upon his students for that elemental knowledge. Unrelated subjects are not well retained. That is why most of us have only vague concepts of anatomy, histology, pathology, physiology, and the like a few years after leaving the dental school. To review these subjects is tedious and will not be done without supervision. To correlate them without review is impossible. The technical courses will be well attended and most satisfactorily taught. Clinical instruction is limited to demonstration at best. We have then a course which represents many of those on the market today; one in which the fundamental structure is a gesture, a few significant features suggested to give a knowing look. A careful exposition of appliance technic generates the implicit confidence in mechanics which is so frequently doomed to disappointment when the tool fails because of the lack of understanding of the workman. And finally the student with his mechanical device goes in search of experience. The damage to the patient is the cost of the experience to the science of orthodontia.

Harold J. Noyes.

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Editorial

An Experiment in Dental and Medical Service

Social and industrial changes seem to be inevitable. It may be that little can be done to prevent change, because change is always taking place, more or less. In dentistry there is danger at this time, however, of unauthorized and radical groups, which represent at most only a small fraction of the membership of the profession, promoting and advocating organization far in advance of necessity. They seek to commit the profession to special social and economic changes concerning which there is wide divergence of opinion among leaders. The profession has reached its present rung on the ladder of progress on the basis of unorganized dental journalism and of untrammeled

individual conscience, and it is well for members of the profession to stop and consider carefully before being stampeded into new, untried, and revolutionary ideas.

In St. Louis a medical and dental service bureau has been opened, similar to one which has been operating successfully in Washington, D. C. The purpose of the bureau is to make it possible and convenient for persons with small incomes to pay medical, dental, and hospital bills according to a system of budgeting which is within their financial means. The bureau organized in St. Louis is operated by the medical and dental societies of St. Louis and St. Louis County. These societies appoint the officers and the board of directors of the bureau from within their memberships. The bureau is more or less of a financial agency for the professional men and for their patients, making it possible for patients to pay off their obligations in terms systematically arranged by the bureau, when the bulk obligation, that is, the bill all in one lump sum, appears impossible for them to pay. The bureau exists primarily for persons who have incurred obligations due to illness and other catastrophies which they are unable to liquidate in one lump sum, and for those who may have postponed necessary medical and dental treatment because of financial straights. These patients are referred to the bureau by their physicians or dentists, and arrangements are made for the patients to pay the bill over a period of time by means of time payments. The payments are made direct to the bureau, and 10 per cent is deducted for its maintenance. Funds which are received by the bureau and are not needed for its operation go into a revolving fund which ultimately is to be used to pay physicians and dentists when worthy patients have met further reverses and are unable to continue their payments.

The bureau in Washington, D. C., is said to have handled 8,000 cases during its first year of existence, and of this number in no instance did patients permit payments to lapse so that it was necessary to bring suit for collection.

In lieu of the many plans and the great confusion which now surrounds the entire set-up and future of the medical and dental professions, this experiment will be watched with a great deal of interest throughout the country. St. Louis physicians and dentists after mature and thorough consideration have thought the plan well worth a trial. If it works, well, that is progress; if it does not work, it can be abandoned for something better.

H. C. P.

News and Notes

Southern Society of Orthodontists

The meeting place of the fourteenth annual meeting of the Southern Society of Orthodontists has been changed from the Signal Mountain Hotel to the Patten Hotel in Chattanooga, Tenn., on January 27, 28, and 29, 1936.

WILLIAM P. WOOD, JR., Secretary
442 W. Lafayette Street
Tampa, Florida

Tennessee State Dental Association

The next meeting of the Tennessee State Dental Association will be held in Memphis, May 11, 12, and 13, 1936, at the Peabody Hotel.

J. FRANK BIGGER, President,
Medical Arts Building,
Memphis, Tenn.

E. J. JUSTIS, Sec'y-Treas.,
Exchange Building,
Memphis, Tenn.

Dental Society of State of New York

The sixty-eighth annual meeting of the Dental Society of the state of New York will be held May 12-15, 1936, at the Waldorf-Astoria Hotel in New York City.

A cordial invitation is extended to all ethical dentists to attend the sessions.

Further information may be obtained by writing to:

DR. CHARLES M. MCNEELY, President
1 Nevins Street
Brooklyn, N. Y.

DR. A. P. BURKHART, Chairman Program Committee
57 E. Genessee St.
Auburn, N. Y.

Chicago Midwinter Meeting

The Chicago Midwinter Meeting will be held at the Stevens Hotel, February 17 to 20, 1936, inclusive.

Note of Interest

Dr. Louis E. Yerkes announces the opening of offices at 36 North 38th Street, Allentown, Pa. Practice limited to orthodontia.

Erratum

In the June, 1935, issue of the JOURNAL, on page 518, through an error Dr. L. M. Waugh was referred to as an orthodontic instructor in Vanderbilt University. Dr. Waugh is Professor of Dentistry and Director of the Orthodontia Department in the School of Dental and Oral Surgery, Columbia University, New York City.

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